

# ALTERNATIVE POLICIES FOR POLLUTION ABATEMENT

THE ONTARIO PULP  
AND PAPER INDUSTRY

SUMMARY AND UPDATE  
(FOR DISCUSSION PURPOSES)

VOLUME III

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1976



Ontario

Ministry  
of the  
Environment

76

The Honourable  
George A. Kerr, Q.C.,  
Minister

Everett Biggs,  
Deputy Minister

TD  
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ALTERNATIVE POLICIES FOR POLLUTION ABATEMENT:  
THE ONTARIO PULP AND PAPER INDUSTRY

SUMMARY AND UPDATE  
FOR DISCUSSION PURPOSES  
VOLUME III

October 1976  
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CHAPTER 1  
INTRODUCTION

A. OBJECTIVES OF THE REPORT

This report is an update and summary of an earlier report entitled Alternative Policies for Pollution Abatement: The Ontario Pulp and Paper Industry. Alternative Policies was written in 1974 to provide background information and analysis for internal discussions within the Ministry of the Environment. The report concluded that the industry had not made sufficient progress in controlling its pollution and that it could afford to achieve the levels of pollution abatement required by the Ministry. Doubts were expressed about the adequacy of the Ministry's policies for achieving the desired degree of pollution abatement and several alternative policies were examined.

The present report reviews the two years that have elapsed since completion of Alternative Policies. It is found that the conclusions reached in Alternative Policies remain largely unaffected. The report consists of three major chapters that deal in turn with the recent and expected economic performance of the pulp and paper industry, the impact of the industry on the environment, and an analysis of policy options for achieving more pollution abatement by the industry. Although this report is intended to stand on its own, frequent references are made to Alternative Policies to indicate where the reader will find additional supporting information and arguments. The Table of Contents for Alternative Policies is presented as Appendix 1 of this report.

abatement. However, this perspective continues to be relevant, especially in connection with those industries, such as pulp and paper, which have failed to make the progress in abating pollution that had been expected.

Whether or not this piecemeal approach to environmental issues will in fact give way to the wider, yet presently imprecise notion of environmental planning, is, at this point in time, an open question. Perhaps the success or failure of whatever policy is finally adopted to deal with the pollution from the pulp and paper industry will indicate better than an abstract argument that it is time to transform environmental planning from a concept into the basis for action.

CHAPTER I - FOOTNOTES

- 1 - Ontario Ministry of the Environment, Alternative Policies for Pollution Abatement: The Ontario Pulp and Paper Industry, (Ontario: Ontario Ministry of the Environment, 1974), page 4-5.

## CHAPTER II

### ENVIRONMENTAL IMPACTS OF THE PULP AND PAPER INDUSTRY IN ONTARIO: A RATIONALE FOR ACTION

#### A. MAJOR ENVIRONMENTAL IMPACTS FROM PULP AND PAPER MILLS

Pulp and paper production complexes, which may include a chlor-alkali plant, discharge a variety of waste products into the air and water, causing different adverse effects. The following summary is not intended to describe any particular mill but to give the reader a general indication of the wastes from the production of pulp and paper and the problems that they cause.

The primary constituents of pulp and paper wastewaters are:

1. Suspended Solids (SS) - bark, woodfibres, dirt and other materials;
2. Soluble Organic Materials - measured as five-day biochemical oxygen demand (BOD<sub>5</sub>). These materials are decomposed by bacteria in the water which consume dissolved oxygen during the process;
3. Dissolved Solids (DS) - dissolved salts and other inorganic chemicals.

In addition, wastewaters may also include:

1. Toxic Substances - such as organic acids and heavy metals;
2. A wide variety of organic and inorganic chemicals.



Gaseous emissions include oxides of sulfur and particulate matter. Solid wastes are also generated by paper mills in large quantities.

Liquid wastes cause the following damages and effects:

1. Some constituents of wastewaters may be dangerous to human health. Residual mercury compounds are of particular significance;
2. Decomposition of organic materials can result in oxygen depletion in waters which threatens the survival of fish and other aquatic animals;
3. Suspended solids coat the bottoms of rivers and lakes and smother aquatic plants and animals;
4. Toxic substances kill aquatic organisms;
5. BOD<sub>5</sub>, suspended solids and toxic substances destroy fish habitats;
6. Fish may be tainted by chemicals. Residues of toxic materials such as mercury accumulate in fish tissues;
7. Colour, foaming, sludge deposits and odours impair the aesthetic properties of the receiving waters.

Gaseous discharges may cause the following problems:

1. Reduced sulphur compounds cause odours;
2. Particulate matter and sulphur dioxide can cause pain and suffering to those who have bronchial diseases;
3. Particulates and sulphur dioxide can harm vegetation.

Waste discharges vary widely from mill to mill depending on the kind of product, the amount of output, the type of process used and the treatment facilities the mill has. The environmental impacts also vary considerably because conditions of the receiving waters or air are different from mill to mill.<sup>1</sup>

Although detailed information concerning waste discharges from each mill and their effects is incomplete, the information that is available is analyzed in Chapter IV of Alternative Policies. Wastewater loadings in terms of BOD<sub>5</sub> and suspended solids are listed for each mill in Table IV-2 of Alternative Policies. Qualitative descriptions of the environmental effects of pulp and paper mills in Ontario are summarized in Table IV-3 of that report. Finally, an assessment of the benefits of pollution abatement at each mill is presented in Table IV-5. It was concluded from these tables that some mills are not causing environmental damages. Furthermore, certain benefits, in terms of possible water uses, could be achieved if those mills which were polluting heavily were to meet Ministry effluent objectives.

For the remainder of the discussion, the focus will be primarily on water pollution from the industry. Water pollution from pulp and paper mills has long been considered the most intractable of all the pollution problems from the industry and was the primary reason that the study reported in Alternative Policies was originally undertaken.

#### B. ENVIRONMENTAL OBJECTIVES IN ONTARIO

Once specific pollution problems are identified, pollution abatement issues may be reduced to two basic questions:

1. How much pollution abatement is desired?
2. How is the desired level of abatement to be achieved technically and administratively?

Technical alternatives for achieving pollution abatement in specific paper mills are examined at length in Appendix G of Alternative Policies. Administrative approaches from the Government perspective constitute the primary focus of the present study and are specifically addressed in Chapter IV of this present volume. The question of how much pollution abatement do we want is analyzed below.

Ideally, the optimal level of pollution abatement would be the level at which the extra social and financial costs incurred would be equal to the additional environmental, social and financial benefits gained.

There are, however, a whole host of complications and difficulties which make it virtually impossible for regulatory agencies to ever determine an objectively "optimal" level of pollution abatement. It is relatively easy to estimate the financial costs of abatement to polluters; but quantitative estimates of the various social and environmental benefits of abatement are either impossible to make or are measured in non-comparable units. In addition, distributional issues cannot be divorced from pollution abatement. What may be an "optimal" level of pollution abatement with respect to economic efficiency may impose unacceptable cost burdens on either the victims of pollution or on polluters.

Despite the fact that the benefits of pollution abatement are very difficult to quantify, environmental control agencies are obliged to establish environmental quality objectives for water, the

air and other environmental media. These quality objectives then form the basis for calculating the allowable effluent loadings for polluters.

Air quality standards are specified in Regulations under The Ontario Environmental Protection Act. Polluters are obliged to adjust their emissions to conform to these standards. If the Government chooses to prosecute a polluter, it need only prove that emissions have exceeded the standards. In practice, however, prosecutions for air pollution are generally based on a contravention of Section 14 of The Environmental Protection Act and not for violating the standards.\*

On the other hand, Provincial Regulations for water quality in lakes and rivers have not been promulgated. Water quality "guidelines" for specific uses have been prepared by the Ontario Ministry of the Environment.<sup>2</sup> These guidelines are not legally binding so that prosecutions for water pollution must be based on the probable or the demonstrated effects of the contaminants.

Wastewater quality objectives were originally proposed in a directive to pulp and paper mills in 1965. These objectives were to be achieved in two phases:

Phase I: Remove suspended solids from the effluents discharged to a level of 50 milligrams per litre or less by December 31, 1966. In 1976, this would amount to a total suspended solids discharge from all mills of about 150 tons per day.

\* Section 14 of the EPA is a general prohibition against pollution.

- Phase II:
- (a) Reduce 5-day biochemical oxygen demand and/or chemical oxygen demand to ensure that the dissolved oxygen (DO) concentration in the receiving waters does not fall below 4 milligrams per litre;
  - (b) Remove substances imparting taste and odours to the receiving waters or to fish;
  - (c) Remove substances toxic to aquatic life; and
  - (d) Control waste components that impair the aesthetic quality of the receiving waters by foam, colour or other effects.

All of these were to be undertaken by December 31, 1969. In addition, the ultimate allowable loadings for suspended solids were to be 15 milligrams per litre, but no time limit was set. These objectives are generally intended to permit the existence of a warm-water fishery in the receiving waters. Effluent loading objectives have been established for each mill in the Province.

While the pulp and paper industry did not initially agree to these objectives, subsequent efforts were made by the Ministry of the Environment to develop voluntary abatement programs that were technically feasible and were not financially damaging. Since 1971, no prosecutions have been laid against pulp and paper mills in order to give the industry time to implement their voluntary programs.

The Federal Government has published effluent guidelines for pulp and paper mills and for chlor-alkali plants under The Fisheries Act.<sup>3</sup> However, the pulp and paper regulations are in force only for new mills or plant expansions. Federal and Provincial authorities co-operate in the development and enforcement of these regulations. The relevant federal regulations are reprinted in Appendix C of Alternative Policies.

C. PROGRESS IN POLLUTION ABATEMENT

After eleven years since the directive was first issued in 1965, to what extent has the pulp and paper industry in Ontario stopped polluting the air and water of the Province? Figure II-1 indicates that the industry as a whole is still short of reaching the interim suspended solids objectives. Moreover, it has made little progress toward curtailing BOD<sub>5</sub> emissions. The "tons per day" expressed on the vertical axis of the graph represents the total amounts of pollutants being discharged by all of the mills.\*

Table II-1 presents the discharge level of BOD<sub>5</sub>, suspended solids and total flow for each mill in the Province during 1970 and 1975 and compares these data with the objectives for each mill. Although more than half of the mills have reduced their BOD<sub>5</sub> and SS discharges in the past four years, few mills have achieved the effluent objectives. Indeed, out of 31 mills, only 3 have met the objectives for BOD<sub>5</sub> and 6 for suspended solids. Twelve mills increased their 1975 BOD<sub>5</sub> effluent loadings over 1970 levels and 6 mills increased suspended solids loadings. Three mills increased both BOD<sub>5</sub> and SS loadings. The environmental significance of these increases depends on the conditions of the receiving waters. Where the receiving waters are already badly polluted rivers,

\* The MOE BOD<sub>5</sub> objectives actually change with changes in output. This is due to the fact the the BOD<sub>5</sub> effluent objectives for some mills is calculated in terms of a percentage reduction in waste loadings rather than the assimilative capacity of the waterbody. However, these changes would be relatively small so that in allowable loadings, the tons per day figure is a fair estimate of the total loading objectives for the industry.

FIGURE II-1

CHANGES IN BOD<sub>5</sub> AND SUSPENDED SOLIDS FROM  
THE PULP AND PAPER INDUSTRY

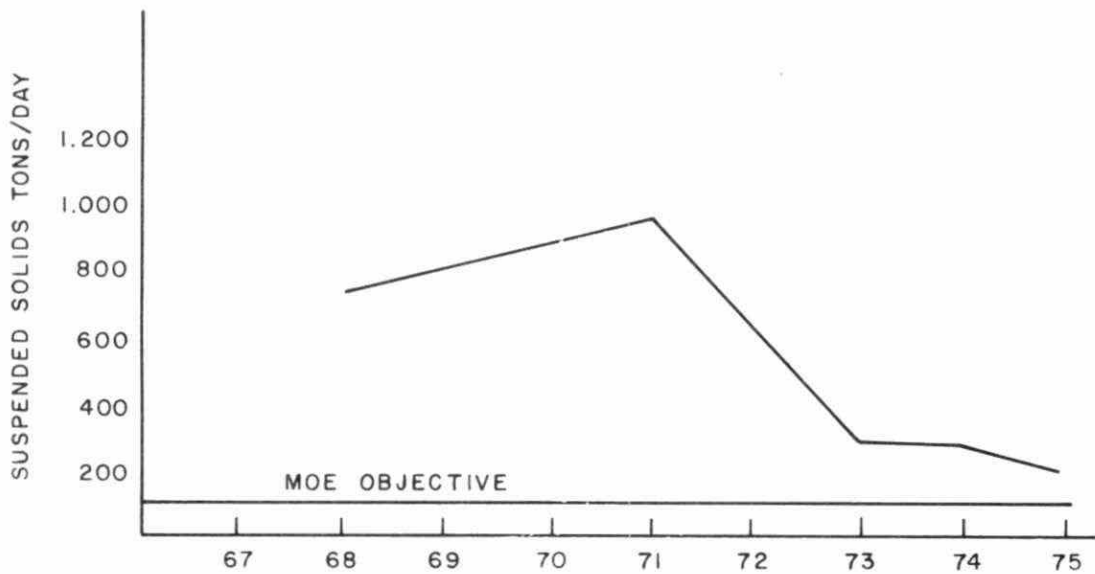
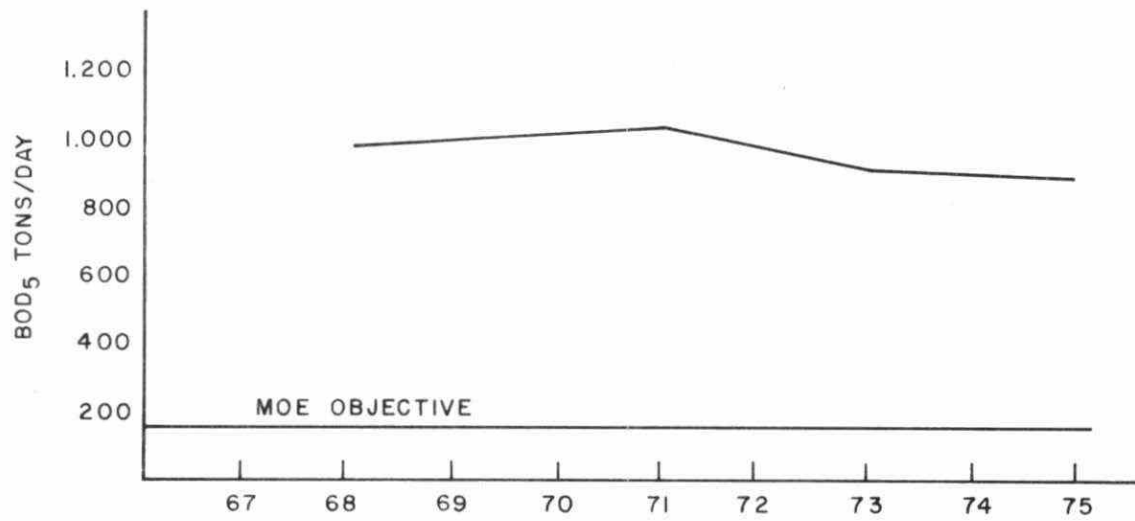


TABLE II - 1

## MILL DATA - 1970 and 1975

Mill	Product	Tons per day		Effluent Million gal./day		Suspended Solids Tons per day		MOE *** Objectives	BOD <sub>5</sub> Tons per day		MOE *** Objectives
		1970	1975	1970	1975	1970	1975		1970	1975	
Abitibi - Iroquois Falls	Newsprint/Box	982	1,058	21.8	19.4	33	31.1	5.4	58	70.0	7.5
- Thunder Bay	Newsprint	464	461	10.7	11.5	2.5	3.3	2.9	30	28.5	6.0
- Mission River (Ft. Wm.)	Newsprint	371	353	7.0	6.5	2.9	3.6	1.6	23	29.6	5.0
- Sault Ste. Marie	Newsprint	346	381	16.5	4.4	23.9	18.9	3.9	43	8.1	-
- Smooth Rock Falls	Pulp	328	343	13.4	7.8	15.6	8.0	2.3	15	8.5	-
Abitibi Provincial - Thunder Bay	Print/Writing	255	307	20.6	14.8	12.0	8.0	5.0	50	26.6	5.0
- Thorold	Print/Writing	238	302	5.8	6.4	20.0	4.6	1.5	7.8	17.6	5.0
Abitibi Panel - Sturgeon Falls	Board/C. Medium	386	281	5.1	12.1	10.6	5.2	1.2	52	47.6	6.0
American Can - Marathon	Pulp	488	468	22.7	19.3	11.6	7.4	5.4	16.2	21.9	5.0
Beaver Wood - Thorold	News./Board	299	333	3.0	5.2	6.0	3.9	1.1	7.0	8.6	-
C.I.P. - Hawkesbury	Chem. Pulp	281	287	25.4	26.4	3.6	3.4	6.5	176	188	40.0
Canadian Johns Manville - North Bay	Board	124	120	.15	.06	.05	.001	0.05	0.15	.001	-
Domtar - Red Rock	News/Box	704	785	22.8	20.1	17	6.1	5.8	23	11.4	5.0
- Trenton	C. Medium	150	175	.4	0.45	.9	0.2	0.1	10	2.0	3.0
- Cornwall	Print/Writing/Pulp	638	637	50.0	28.6	90	12.6	8.0	76	11.0	-
- St. Catharines	Print/Writing	87	129	2.0	2.2	1.8	0.13	0.55	1.2	0.39	-
- Thorold	Building Paper	52	60	0.35	0.14	0.45	0.38	0.5	.2	0.36	0.5
E.B. Eddy - Ottawa	Print/Writing	215	249	3.8	4.2	5.9	4.2	1.0	1.8	2.6	-
Eddy Forest - Expanola	Pulp/Paper	577	777	22.4	35.3	20	10.3	6.2	25.5	27.7	5.0
Great Lakes Paper - Thunder Bay	Newsprint/Pulp	1,748	1,707	53.0	36.1	82	18.5	9.5	148	66	15.0
Kimberly Clark - Terrace Bay	Pulp	420	434	19.2	47.6	3.3	7.7	5.5	27.7	37	5.0
- St. Catharines	Tissue	106	100	2.5	2.34	3.0	.13	0.75	2	0.87	-
- Kapuskasing	Tissue	74	72	3.6	3.7	4.0	4.4	0.65	1.5	1.5	-
- Huntsville	Tissue	**	94	.16	.1	0	0	-	0	0	-
Ontario Minnesota - Fort Francis *	Newsprint/Pulp	646	842	7.4	18.5	5.5	19.3	4.5	5	13.7	5.0
- Kenora	Newsprint	725	720	11.4	13.3	17	12.5	3.0	50	38.7	12.5
Ontario Paper - Thorold	Newsprint	798	725	23.0	27.6	15.5	13.8	5.5	65	24.2	12.5
Reed Paper - Dryden	Pulp/Paper	576	587	31.0	31.6	25.0	24.9	8.0	24	46.2	5.0
Spruce Falls P & P - Kapuskasing	Newsprint/Pulp	1,153	1,027	34.0	33.2	96.0	35.0	6.5	164	120.0	5.0
Strathcona Paper - Strathcona	Boxboard	91	120	0.8	0.55	0.1	0.165	0.4	12	0.55	-
Trent Valley - Glen Miller	Boxboard	78	102	2.9	1.3	2.6		0.1	1.3	0.78	-
TOTAL		13,066	14,034	442.86	440.74	531.8	269.0		1,116.4	860.0	

\* New kraft mill went on stream in late 1971

\*\* New tissue mill went on stream in March 1971. Over 90% of the water is recycled and the 10% discharged contains trace TSS, BOD<sub>5</sub>

C. Medium is corrugating Medium

Box. is boxboard

N.A. - not available

Chem Pulp is chemical dissolving pulp

News is newsprint

Print/Writing is printing and writing paper

\*\*\* MOE Objectives taken from "A Proposal to the Ontario Government -  
Financial Assistance to Accelerate The Water and Air Pollution  
Abatement Programs" Ontario Ministry of the Environment, April 1973.



increases in waste loadings may have little or no impact. However, where the receiving waters are lakes, the zone affected by waste discharges may be increased so that the damages due to pollution could be increasing.

Much more has been accomplished in the way of suspended solids reduction than BOD<sub>5</sub> abatement because there is a greater economic incentive to reduce suspended solids, especially if this is done by in-plant changes. Suspended solids contain fibres which can be used to make paper. Consequently, there has been a financial return to mills which have increased their efficiency and have recovered fibre which would otherwise have been sewerred. The dissolved organic materials which cause oxygen depletion are primarily sugars and alcohols for which there are little or no markets or which are expensive and difficult to recover. There is no corresponding economic incentive to reduce BOD<sub>5</sub> loadings and, accordingly, mills have accomplished little in this direction.

Specific problem mills and locations are examined in the next section.

#### D. WATER POLLUTION PROBLEM AREAS

The data presented in Chapter IV of Alternative Policies were used to establish abatement priorities among different mills. The mills listed in Table II-2 in this section have been identified by the Ministry of the Environment and the International Joint Commission as specific problem situations.<sup>4</sup> Four of these mills are classified as potentially dangerous to human health. These are:

TABLE II-2

## MILLS WHICH CONSTITUTE PARTICULAR WATER POLLUTION PROBLEMS

<u>Receiving Waters</u>	<u>Mill</u>	<u>Type of Mill</u>	<u>Flow MGPD (1975)</u>	<u>BOD 1975 Ton/Day</u>		<u>Suspended Solids 1975 Ton/Day</u>		<u>Comments and other Problems</u>
				<u>Actual</u>	<u>Objectives</u>	<u>Actual</u>	<u>Objectives</u>	
Lake Superior, Thunder Bay Harbour	Abitibi Provincial Paper, Thunder Bay	Sulfite Pulp (Ca), Fine papers	24.8	26.6	5.0	12.0	5.0	
	Abitibi Paper Co., Fort William Mill, Thunder Bay	Sulfite Pulp (Na), Newsprint	6.5	29.6	5.0	3.6	1.6	Possible contamination of water supply to Indian Reserve near Chippawa Park.
	Abitibi Paper Co., Port Arthur, Thunder Bay	Sulfite Pulp (Na), Newsprint	11.5	28.5	6.0	3.3	2.9	Possible contamination of water supply at Bare Point Intake for City of Thunder Bay.
Lake Superior, Kaministiquia River	Great Lakes Paper, Thunder Bay	Kraft Pulp, Sulfite Pulp, Newsprint	36.1	66.0	15.0	18.5	9.5	Anoxic conditions for 6 miles to Thunder Bay. Constructing a new experimental kraft pulp mill with complete water & chemical recycling.
Lake Superior, Peninsula Harbour	American Can, Marathon	Kraft Papers	19.3	21.9	5.0	7.4	5.4	Increased BOD <sub>5</sub> loadings from 1970 to 1975. A current source of mercury to Lake Superior.
Lake Superior, Nipigon Bay	Domtar Packaging, Red Rock	Kraft Pulp, Newsprint	20.0	11.4	5.0	6.1	5.8	Toxicity in effluents, odours & fish tainting. Mercury-tainted fish in the area.
Lake Superior, Jackfish Bay	Kimberly Clark, Terrace Bay	Kraft Pulp	47.6	37.0	5.0	7.7	5.5	Both BOD <sub>5</sub> and suspended solid loadings were increased during 1975, toxicity.
Wabigoon River	Reed Paper, Dryden	Kraft Papers	31.6	46.2	5.0	24.9	8.0	This mill increased its BOD <sub>5</sub> loadings substantially in 1975; source of mercury contamination to Wabigoon River.
Kapuskasing River	Spruce Falls Paper (Kimberley Clark)	Sulfite Pulp (Ca),	33.2	120.0	5.0	35.0	6.5	Taste and odours.
Sturgeon River, Lake Nipissing	Abitibi Paper Co., Sturgeon Falls	Sulfite (NSSC) Corrugating Medium	12.1	47.6	6.0	5.2	1.2	

continued...

TABLE II-2 - Continued

<u>Receiving Waters</u>	<u>Mill</u>	<u>Type of Mill</u>	<u>Flow MGPD (1975)</u>	<u>BOD 1975 Ton/Day Actual Objectives</u>		<u>Suspended Solids 1975 Ton/Day Actual Objectives</u>		<u>Comments and other Problems</u>
Abitibi River	Abitibi River, Iroquois Falls	Sulfite (Na), Newsprint	19.4	70.0	7.5	31.1	5.4	Mill wastes cause DO sag for almost 25 miles below the mill.
Mattagami River	Abitibi, Smooth Rock Falls	Kraft Pulp	7.8	8.5	-	8.0	2.3	Increased BOD <sub>5</sub> loadings between 1970 and 1975.
Lower Spanish River, Lake Huron	Eddy Forest Products,	Kraft Pulp, Fine Papers	35.3	27.7	5.0	10.3	6.2	A source of tainted fish in North Channel 30 miles downstream.
Ottawa River	Canadian Int'l Paper, Hawkesbury	Sulfite Dissolving Pulp	26.4	188.0	40.0	3.4	6.5	Prosecuted in 1974 for an air pollution offence.
Old Welland Canal, Thorold, Ontario	Abitibi Provincial Paper, Thorold	Fine Papers	6.4	17.6	5.0	4.6	1.5	The primary effects are aesthetic- colour and foaming. There is a growing demand for further cleanup due to proximity to urban population centres.
	Ontario Paper Co., Thorold	Sulphite, Newsprint	27.6	24.2	12.5	13.8	5.5	
	Kimberly Clark, St. Catharines	Tissue	2.34	0.87	-	0.13	0.75	
	Domtar Construction, Thorold	Building Board	0.14	0.36	0.5	0.38	0.5	
	Domtar Fine Papers, St. Catharines	Fine Papers	2.2	0.39	-	0.13	0.55	
TOTAL -	Old Welland Canal		38.68	43.42	18.0	19.04	8.8	
Rainy River	Ontario Minnesota Pulp & Paper Co., Fort Frances	Kraft Newsprint	17.5	19.6	5.0	14.5	4.5	Mill is located near residential and commercial areas. Has been prosecuted for air pollution offence.
Winnipeg River	Ontario Minnesota Pulp & Paper Co., Kenora	Sulphite, Newsprint	12.7	43.9	12.5	11.7	3.0	Large accumulations of fibre and colour.

1. Reed Paper in Dryden - This mill discharges  $BOD_5$  and suspended solids which are currently in excess of objectives and are grossly contaminating the Wabigoon River. Mercury residues accumulate in sediments, and contaminated fish are suspected of having poisoned downstream residents. The attached chlor-alkali plant no longer discharges mercury.
2. American Can at Marathon - This mill discharges  $BOD_5$  and suspended solids into Peninsula Harbour on Lake Superior. Mercury is being discharged from the attached chlor-alkali plant.
3. Abitibi at Fort William (Thunder Bay) -  $BOD_5$  and suspended solids are discharged into the mouth of the Mission River. This mill is a potential source of contamination of the water supply to the Fort William Indian Reserve.
4. Abitibi at Port Arthur (Thunder Bay) -  $BOD_5$  and suspended solids from this mill are possible contaminants at the Bear Point intake for the City of Thunder Bay.

In addition, five mills are identified as causing gross deterioration to the environment due to  $BOD_5$  and suspended solids. These mills include:

1. Abitibi Paper, Iroquois Falls,
2. Abitibi Paper, Smooth Rock Falls,
3. Canadian International Paper, Hawkesbury,
4. Spruce Falls Power & Paper (Kimberly Clark), Kapuskasing,
5. Kimberly Clark, Terrace Bay.

Two mills were prosecuted in 1975 for air pollution offences. These were the Ontario - Minnesota Company at Fort Frances and the CIP mill at Hawkesbury.

Eleven years have elapsed since the pulp and paper industry was asked to clean up its wastewaters. Moreover, Ontario Water Resources Commission and Ministry of the Environment officials have worked closely with these mills to try to develop voluntary programs that would be both technically and economically feasible. Despite these considerations, the pulp and paper industry continues to generate about 87% of the  $BOD_5$  being discharged by all industries directly into lakes and rivers in the Province.<sup>5</sup> While some mills have made substantial progress, others continue to dump hundreds of tons of oxygen-depleting wastes into lakes and rivers each week. American Can's chlor-alkali plant continues to discharge mercury compounds despite the recognized dangers of mercury accumulation in sediments and fish.

It is concluded, therefore, that:

1. Based on past experience, the mills cited in Table II-2 are unlikely to achieve MOE  $BOD_5$  and Federal toxicity objectives without stronger inducements from the Government;
2. Despite considerable improvements in suspended solids abatement, for many mills, the damages to receiving waters are the same now as they were eleven years ago; and
3. If the industry continues to expand, pollution problems could increase as well.

CHAPTER II - FOOTNOTES

- 1 A fuller account of these environmental impacts may be found in Birkes, F., et al., eds. Environmental Aspects of the Pulp and Paper Industry in Quebec, 2nd ed. (Montreal: McGill University Press, 1972).
- 2 Ontario, Ministry of the Environment, Guidelines and Criteria for Water Quality Management in Ontario, (Toronto: Ontario Ministry of the Environment, 1974).
- 3 Canada, Environment Canada, Pulp and Paper Effluent Regulations, Regulations, Codes and Protocols, Report I, (Ottawa: Environment Canada, Water Pollution Control Directorate, November 1971), see page 1889.
- 4 International Joint Commission, Great Lakes Water Quality Board, Great Lakes Water Quality 1975, Appendix C, Remedial Programs Subcommittee Report, (Windsor, Ontario: International Joint Commission, June 1976), pages I-1 and I-2.
- 5 Ontario, Ministry of the Environment, Status of Industrial Water Pollution Control in Ontario, (Ontario: Ontario Ministry of the Environment, 1973).

### CHAPTER III

#### ECONOMIC CONDITIONS AND EXPECTATIONS

##### A. REVIEW AND OBJECTIVES

The Report, Alternative Policies, contained an extensive review of pulp and paper market conditions up to and including the first half of 1974. An analysis of the structure of the industry was also presented. It was found that pulp and paper mills in Ontario served three primary product markets: sulphate (kraft) market pulp, newsprint and tariff-protected paper and paperboard products. Large proportions of the market pulp and newsprint production are exported to the U.S. and elsewhere. Newsprint is by far the dominant product of the industry. Of the paper and paperboard products, fine papers and linerboards are the most important in terms of output.

The demand for market pulp and paper products was found to be cyclic with the years 1970-71 being particularly low periods in the cycle. This is apparent from output data presented in Table III-1. However, the industry recovered rapidly and 1974 saw record profits for nearly all companies. The health of the newsprint and market pulp sectors in Ontario are largely determined by business conditions in the United States where most of these products are sold.

TABLE III-1

## PULP AND PAPER PRODUCTION - CANADA, ONTARIO

		PRODUCTION (000's TONS)								
		PULP			PAPER					
		Total Sulphate	Sulphate Bleached Softwood	Total Pulp	Newsprint	Printing & Fine Paper	Container Board		Total Paper-Board	Total Paper & Paperboard
							Liner	Corrugating Medium		
CANADA	1968	6,034		16,762	8,031	674	723	299	1,764	11,656
	1969	6,945		18,590	8,818	759	777	336	1,907	12,788
	1970	6,707		18,308	8,719	905	776	373	1,850	12,679
	1971	7,132	3,450	18,234	8,455	931	797	389	1,871	12,661
	1972	7,889	3,920	19,239	8,820	971	925	457	2,140	13,474
	1973	8,893	4,580	20,462	9,140	983	1,104	494	2,515	14,293
	1974	9,395	4,987	21,753	9,548	1,164 <sup>(1)</sup>	1,203 <sup>(1)</sup>	463 <sup>(1)</sup>	2,577 <sup>(1)</sup>	14,985
	1975	7,096	4,075	16,210	7,679					
	(6 mo.) 1976	4,257	2,483	9,220	4,164					
ONTARIO	1968	1,238		3,644	1,760	448			556	2,954
	1969	1,328		3,961	1,797	455			571	3,006
	1970	1,368		3,969	1,858	533			593	3,178
	1971	1,321		3,800	1,773	514			638	3,119
	1972	1,521		3,938	1,784	562			689	3,235
	1973	1,540		4,044	1,950	573			801	3,563
	1974	1,624 <sup>(2)</sup>		4,274 <sup>(2)</sup>	1,960 <sup>(2)</sup>	698			832	3,752
	1975	1,162 <sup>(2)</sup>		2,777 <sup>(2)</sup>	1,257 <sup>(2)</sup>					
	(6 mo.) 1976	589 <sup>(2)</sup>		1,422 <sup>(2)</sup>	642 <sup>(2)</sup>					

(1) These figures come from Statistics Canada; all other Canada figures come from CPPA.

(2) These figures come from CPPA; all other Ontario figures come from Statistics Canada.

Sources: Statistics Canada  
CPPA



It was concluded that air and water pollution abatement programs are being enacted in the U.S. and Scandinavia which will involve long-run costs at least as great as those contemplated for Ontario. Hence, the pollution abatement objectives that have been established for Ontario mills will not likely put the industry at a disadvantage to these other producing areas. There are other cost factors which are hurting Ontario mills vis-a-vis producers in the U.S. and Scandinavia, but environmental costs do not appear to be one of them.

It is also concluded that the short-run disparities between old and new mills or between Ontario and Quebec mills which might result from compliance with Ontario environmental objectives will not precipitate mill closures or wholesale moves out of the Province.

Of particular interest is the observation that even during an acknowledged bad year, 1971, the before-tax profit margins for most mills were between \$8.00 and \$30.00 per ton. These margins are well above the pollution abatement costs which were estimated to amount to about \$5.00 per ton of product.

It was not possible to determine precisely which firms, if any, might reduce output or lay off workers if compliance with environmental objectives was achieved. It is, in fact, highly unlikely that mills would be closed down by the Government for

environmental reasons unless human health was clearly and directly endangered. However, mill closures are possible if the industry undergoes another period of low demand and falling prices. Ten mills were identified as having a potential for closure if the industry went through another severe recession. Significantly, none of these mills were closed as a result of the 1975 recession.

The important conclusion derived from the economic analysis in Alternative Policies is that the firms in the Ontario pulp and paper industry would be able to absorb the costs of meeting the environmental objectives as established by the Ministry of the Environment without mill closures, without substantial layoffs and without a significant deterioration in the industry's profit performance.

The objective in this chapter is to determine whether these conclusions are still valid. To do this, the relevant events and trends that have occurred between 1974 and the present (mid-1976) will be examined and analyzed. In addition, expectations of and for this industry will be assessed in terms of demand, costs, profits and technology.

B. PRICES, COSTS AND PROFITS - 1973-1976

A number of the trends and events that have occurred between January 1974 and June 1976 have been particularly favourable to the pulp and paper industry. One of the most important of these trends was the strong growth in demand and prices that occurred between 1973 and 1975. By the beginning of 1974, the unprecedented wood pulp shortage that had built up through the boom period of 1973 had begun to ease up. During this time, many mills used waste paper to supplement their fibre supply so that the boom was felt in the waste paper market as well. Demand for paper products began to ease off in mid-1974 as publishers and other consumers completed their inventory buildups, but sales and output continued at high levels. Mills themselves had built up large product inventories.

The strikes that hit the industry in the fall of 1975 were fortuitously timed from the industry's point of view. Demand for paper products, especially newsprint, had fallen to the extent that the industry would likely have had to go on short time which would have resulted in higher average costs of operation. The strikes permitted the mills to reduce output, but still maintain sales from inventory without reducing prices. The degree to which output has been reduced is shown in Table III-1.

The Federal Anti-Inflation Board was established in early 1975. As indicated by the price indices in Figures III-1, III-2, III-3, and III-4, the Board's actions have appeared to curtail price increases for domestically consumed products like fine papers and container board. The prices of pulp and newsprint for export levelled off in 1975, but newsprint prices have begun to rise again. The price of kraft pulp for export now stands at \$372.00 per ton, while newsprint brings about \$300.00 per ton in the United States.

There are a number of forces which have acted or will act to increase the costs of producing paper in Ontario. First of all, the stumpage fees paid by companies to the Government for the rights to harvest wood are being studied and are likely to be revised, upwards.<sup>1</sup> After labour, these stumpage fees are the largest cost element faced by pulp and paper companies. The Government of Ontario has not yet made a decision about these policies. The Government is also considering the adoption of a program of controlled clearcutting.<sup>2</sup> This policy could also have the effect of increasing wood costs to paper mills.

With respect to labour, a series of strikes and walkouts were undertaken against the industry during the second half of 1975. The workers have now settled within AIB guidelines and are back to work in most mills. However, companies which sell products domestically claim that they have lost Canadian customers to U.S. papermakers during the strike.<sup>3</sup>

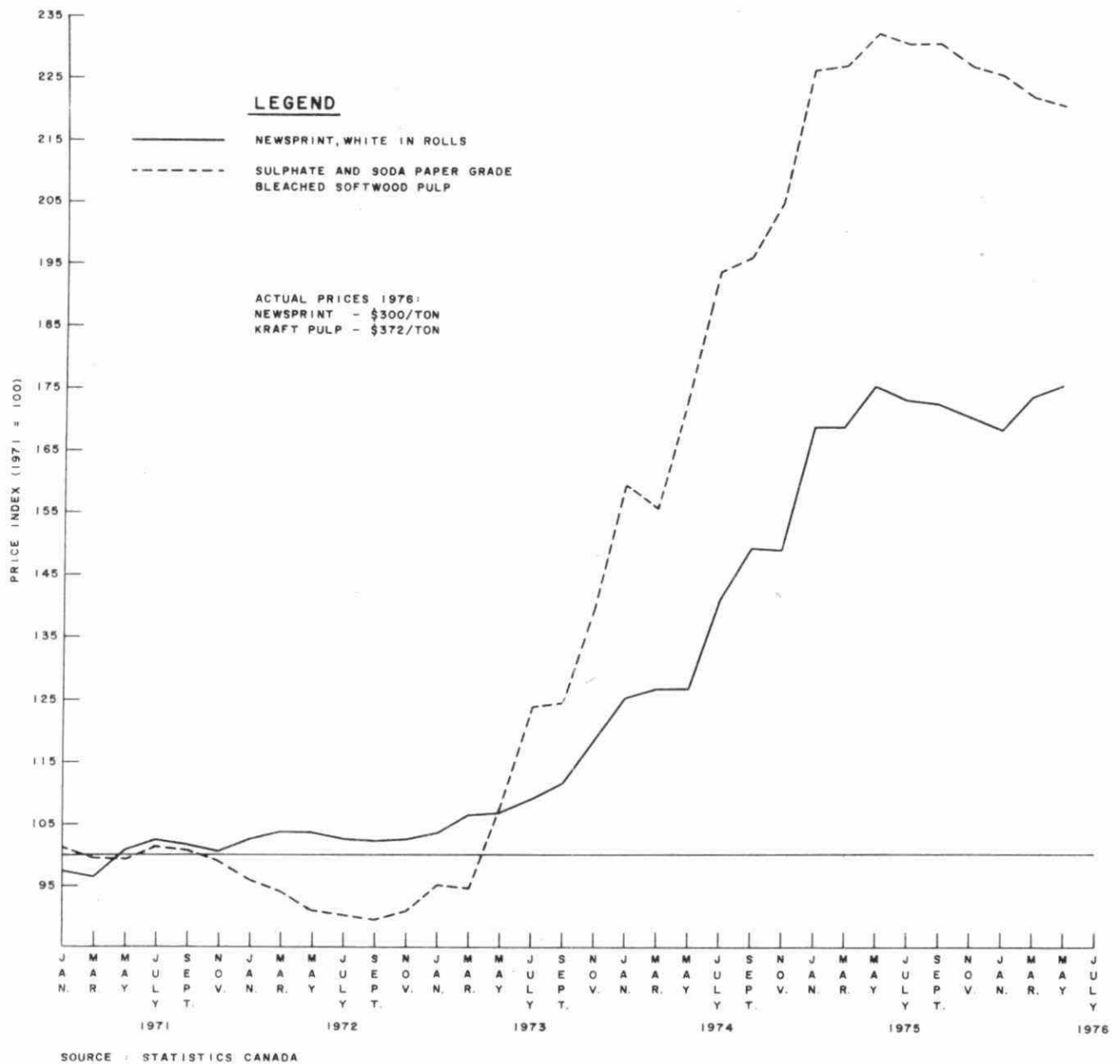


FIGURE III - 1 INDUSTRIAL SELLING PRICE INDEXES - NEWSPRINT AND SULPHATE PULP FOR EXPORT-ACTUAL PRICES

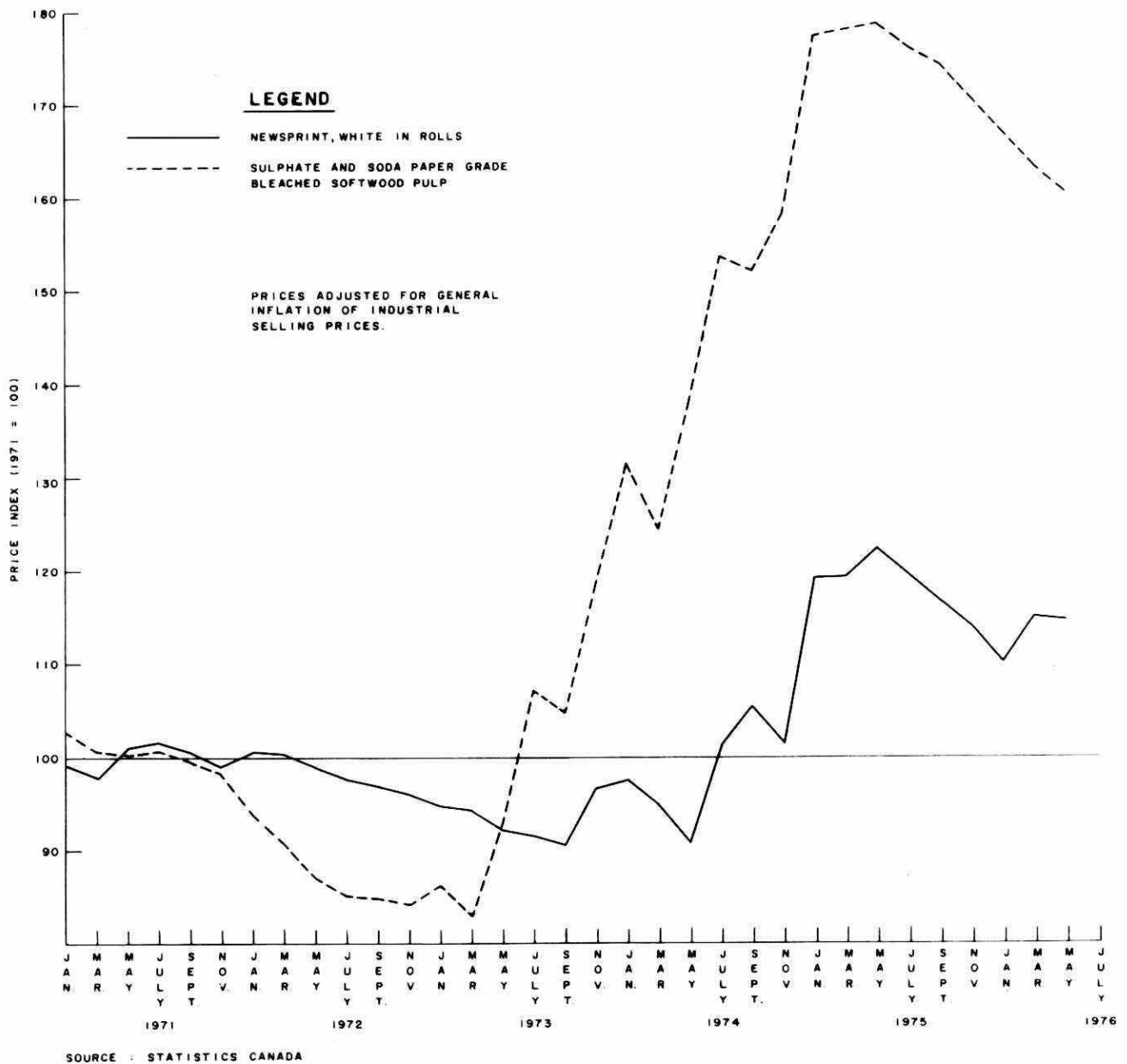


FIGURE III - 2 ADJUSTED INDUSTRIAL SELLING PRICE INDEXES -  
NEWSPRINT AND SULPHATE PULP FOR EXPORT

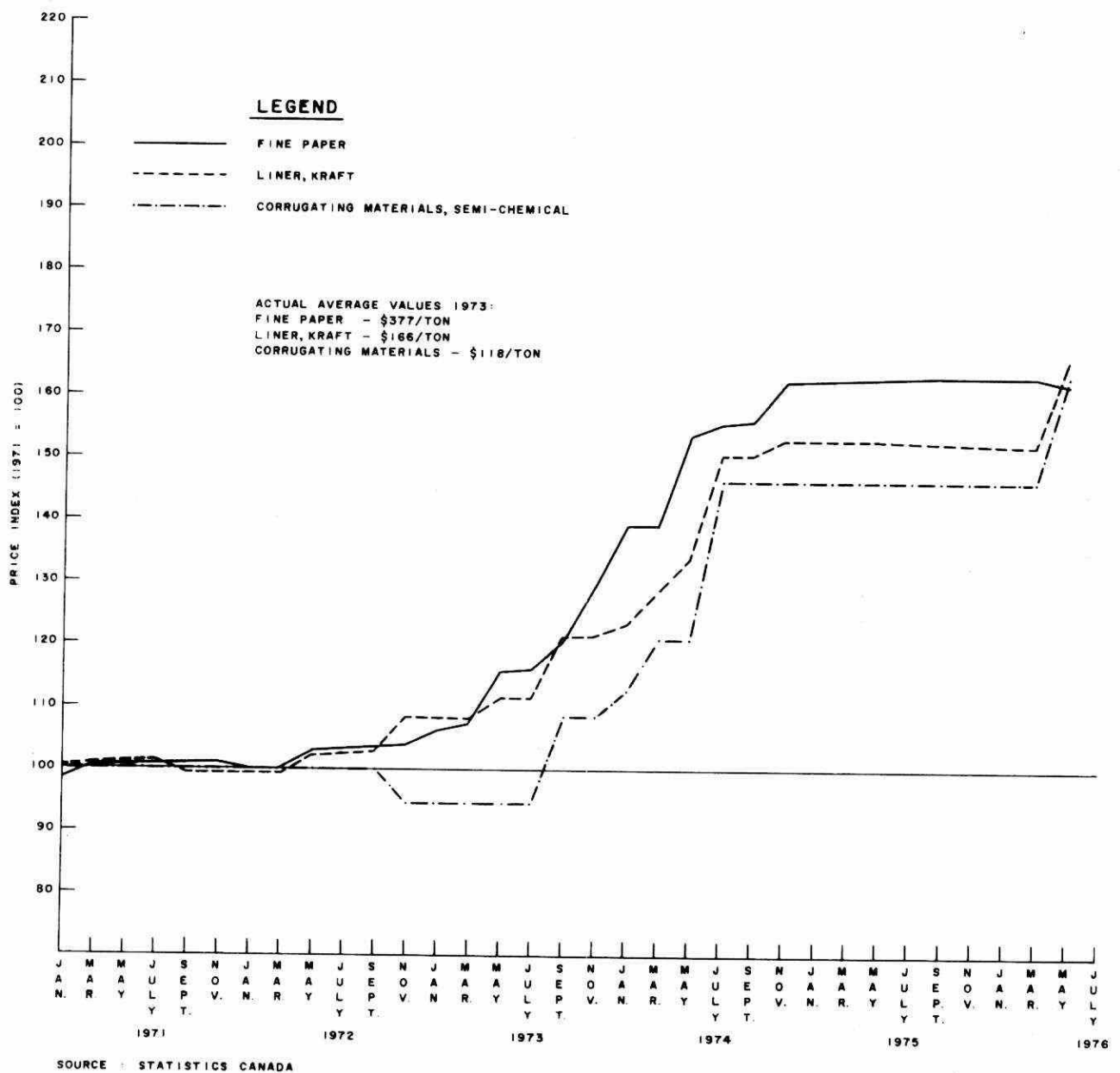


FIGURE III - 3 INDUSTRIAL SELLING PRICE INDEXES - FINE PAPER, LINERBOARD AND CORRUGATING MATERIALS - ACTUAL PRICES

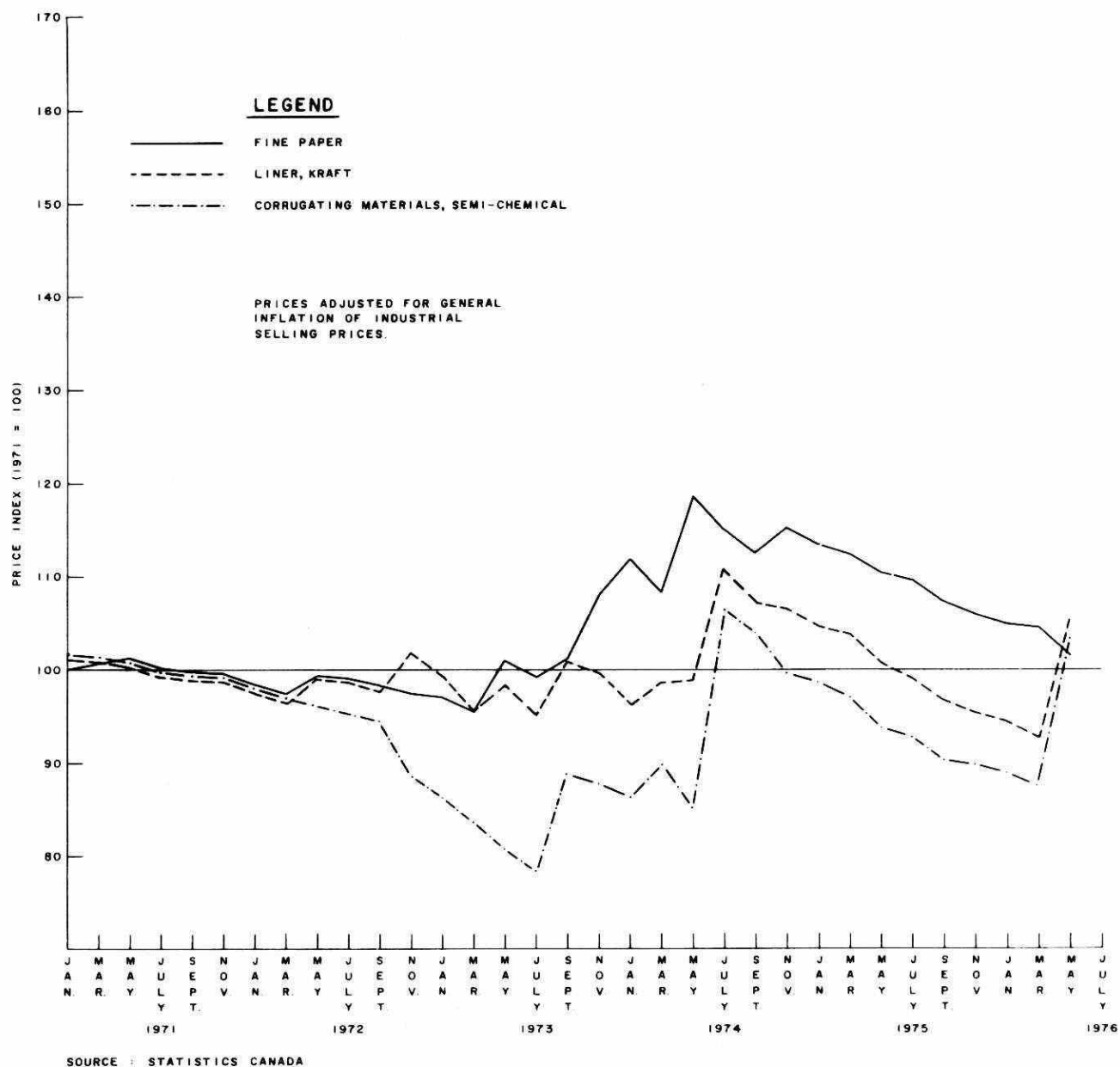


FIGURE III - 4 ADJUSTED INDUSTRIAL SELLING PRICE INDEXES -  
FINE PAPERS, LINERBOARD AND CORRUGATING MATERIALS



Another cost component which has experienced sharp increases during the past two and a half years has been energy. This has spurred the pulp and paper industry, as well as other industries, to search for cheaper energy sources and to reduce energy consumption. There appears to be substantial scope for increasing the use of wood wastes and residues as energy sources.\*

The concentration of economic activity in the pulp and paper industry has increased somewhat by the acquisition of Price Ltd. by Abitibi in 1975. Moreover, paper companies have been securing their fibre sources and diversifying their operations by constructing new saw mills. The chips and sawdust produced at these lumber mills are pulped to make paper. However, despite the high operating ratios and strong demand that occurred through 1973 and 1974, no major expansion programs have been undertaken by the industry.\*\*

\* Of five energy intensive industries studied for the Ford Foundation Energy Policy Project, it was estimated that the paper industry could reduce its external energy requirements by the greatest amount. See E. P. Gyftopoulos, Lazaros J. Lazaridis and Thomas F. Widmer, Potential for Effective Use of Fuel in Industry, a Report to the Energy Policy Project, Cambridge, Massachusetts: Ballinger, 1974.

\*\* Three firms are expanding existing mills, but no new mills have been planned.

The profit data presented in Tables III-2 and III-3 clearly show the magnitude of the recovery experienced by the industry from 1971 to 1975. The year 1974 was a record year for profits in the pulp and paper industry. Profits dropped somewhat in 1975 due to strikes and to a slight softening of demand. However, profits in 1975 were still substantially higher than those registered in 1971 when the industry was in the throes of a recession. It is of particular interest to note in Table III-2 that the profit per ton of each firm has generally increased since 1971.

The data in Table III-3 show that the ratio of after-tax profit to capital employed (i.e. "return on investment") tends to be lower in the "Paper, Allied Industries and Forestry" sector than for total manufacturing. Similarly, the return on investment to the companies listed in Table III-3 are lower than Total Manufacturing as well. While these data are by no means conclusive, one interpretation is that Eastern Canadian pulp and paper companies are inefficient relative to other industries. This may be due to the fact that, in an economy with relatively new industrial plant, Eastern Canadian pulp and paper mills tend to be very old. However, the return on investment to the pulp and paper companies exceeded, with the exception of Abitibi, the Total Manufacturing figure in 1974.

Of course, it would be a mistake to attach too much significance to these data owing to the basis on which they were estimated. Nevertheless, they do add strong support to the view

TABLE III - 2

## PROFITS OF PULP AND PAPER COMPANIES WITH MILLS IN ONTARIO

COMPANY		Net Profits excluding Extra-ordinary Items	Cash Flow Total	Total Pulp and Paper Production	Net Profit per ton
		(\$ 000)	(\$ 000)	(000 tons)	(\$/ton)
ABITIBI	1969	12,141	28,200	1,425.3	8.52
	1970	5,032	21,000	1,409.5	3.57
	1971	4,123	20,800	1,498.9	2.75
	1972	8,516	25,100	1,348.7	6.31
	1973	30,552	48,248	1,579.1	19.35
	1974	45,880	67,123	1,631.0	28.13
	1975	13,329	55,400	956.6	13.93
DOMTAR (1)	1969	20,000 (13,000)	47,100	1,476.3	8.81
	1970	17,600 (11,440)	42,800	1,491.4	7.67
	1971	10,500 ( 8,825)	41,000	1,433.8	4.76
	1972	17,468 (11,354)	49,600	1,408.5	8.06
	1973	40,600 (26,390)	73,700	1,422.1	18.56
	1974	82,500 (53,625)	123,600	1,391.7	38.53
	1975	35,300 (22,900)	76,300	960.8	23.88
GREAT LAKES PAPER	1969	5,039	10,317	518.6	9.72
	1970	4,345	9,963	519.8	8.36
	1971	3,237	9,710	506.6	6.39
	1972	1,608	8,501	504.8	3.19
	1973	7,621	14,843	600.0	12.70
	1974	14,938	30,778	524.0	28.51
	1975	6,427	23,848	377.0	17.05

continued...

TABLE III - 2 continued

COMPANY		Net Profits excluding Extra-ordinary Items	Cash Flow Total	Total Pulp and Paper Production	Net Profit per ton
		(\$ 000)	(\$ 000)	(000 tons)	(\$/ton)
REED PAPER (2)	1969	3,168	9,289	588.4	5.38
	1970	2,413	8,820	624.9	3.86
	1971	2,113	8,133	571.8	3.70
	1972	2,556	8,209	617.6	4.14
	1973	16,588 (11,612)	25,705	608.1	19.09
	1974	34,257 (29,980)	44,445	648.6	36.97
	1975	12,309 ( 8,616)	21,074	488.1	17.65
INTERNATIONAL PAPER (3) (U.S.)	1969	114,000 (59,280)	193,000	6,995	8.47
	1970	82,000 (42,640)	132,000	6,968	6.12
	1971	69,000 (35,800)	151,000	8,677	4.14
	1972	103,000 (53,560)	201,000	7,189	7.45
	1973	160,000 (83,260)	264,000	7,117	11.69
	1974	263,000 (136,760)	371,000	7,710	17.74
	1975	218,000 (113,360)	382,000	6,136	18.47

<sup>1</sup> About 65% of Domtar's sales is pulp and paper products. It is assumed that 65% of the profits are also derived from pulp and paper. The 65% figures given in brackets were used to calculate the net profit per ton of output.

<sup>2</sup> Figures from 1969 to 1972 are taken from the annual reports of Anglo-Canadian Pulp and Paper Mills Ltd. From 1973 on, Anglo-Canadian reports were consolidated with other Reed Paper holdings and their annual report was no longer published. Current data is taken from Reed Paper annual reports. About 95% of Anglo-Canadian sales were pulp and paper products so that their total net earnings are used to calculate profit/ton. About 70% of Reed Paper sales are pulp and paper products produced by the former Anglo-Canadian mills. 70% of net profits are given in brackets and these figures are used to calculate profit/ton.

<sup>3</sup> About 52% of sales is pulp and paper products. Fifty-two percent of the Company's net profits are given in brackets. These figures are used to calculate net profit per ton.

Sources: Annual Reports of the respective companies.

TABLE III-3 Ratio of Profits After Taxes to Capital Employed. <sup>(1)</sup>

	1969	1970	1971	(percent) 1972	1973	1974	1975
Total Canadian Manufacturing	6.9	5.0	6.4	7.7	10.2	11.8	9.4
Paper, Allied Industries and Forestry	4.8	2.2	1.5	1.5	5.9	11.8	5.4
Companies with Mills in Ontario:							
Canadian: Abitibi	3.6	1.4	1.2	2.4	8.4	7.6	1.7
Great Lakes Paper	6.2	6.5	4.4	2.2	9.6	13.5	4.1
Domtar	4.3	3.8	2.3	3.8	8.6	15.5	5.9
British: Reed Paper	-	-	-	-	9.8	16.4	3.9
- Anglo-Canadian <sup>(2)</sup>	3.0	2.3	2.1	2.5	-	-	-
American: International Paper	7.3	4.7	3.8	5.7	8.4	11.7	7.7

(1) Capital employed is equal to total liabilities and shareholders equity minus total current liabilities. Profit data is net profits before extraordinary items. This table does not coincide exactly with Table III-33 in "Alternative Policies for Pollution Abatement: The Ontario Pulp and Paper Industry" due to calculation errors made in that table.

(2) Anglo-Canadian annual reports were consolidated with those of other Reed Paper subsidiaries in 1973.

Sources: Statistics Canada, Industrial Corporations Financial Statistics (various issues) 61-003 Quarterly.

Annual Reports of Specified Companies.

that the fortunes of the pulp and paper industry have improved markedly in recent years. Even with the long strikes in 1975, the economic condition of the pulp and paper companies operating in Ontario has been strong and profitable. Events of the past two years have not affected the conclusions reached in Alternative Policies. There is no reason to believe that the costs of achieving pollution abatement levels specified by the Ministry of the Environment will seriously jeopardize the profitability of the paper companies in question or cause them to close specific mills. Moreover, as the following section shows, the medium term outlook for the industry is good and serves to reinforce these conclusions.

C. EXPECTATIONS

1. Economic Conditions

A number of recent forecasts and projections for the North American pulp and paper industry that were reviewed for this study indicate only varying degrees of optimism. Despite high demand and record profits in 1974, "over expansion" of new capacity was prevented throughout North America by high interest rates, scarce capital, high construction costs and high debt-to-equity ratios for many firms.\*<sup>4</sup> Consequently, the industry in Canada and the U.S. avoided the production gluts and falling prices that traditionally follow boom periods. One analyst predicts that the last half of the

\* "Over expansion" implies increasing production capacity to the extent that prices will be affected. 1975 saw the lowest capacity increase in 20 years. See PAPER TRADE JOURNAL, "Capacity Increasing, but at a Slower Rate, API Reports", November 1, 1975, page 1 and 28.

seventies will witness a seller's market with marked increases in profitability, return on sales, return on assets and return on equity.<sup>5</sup>

A major study completed by the Pulp and Paper Research Institute of Canada concluded that production of Canadian paper and paperboard would continue to increase at an average annual rate of 3.6% between 1970 and 1980 and by 4% per year from 1980 to 1990.<sup>6</sup> It was implied that demand will also increase by a similar rate during that time period. This study was based on an extensive series of questionnaires and interviews of more than fifty informants and addressed such topics as fibre supply, technology, labour, investment, energy costs and Governmental relations in a Canadian setting. The primary conclusion of the study is that, barring natural or political upheavals, the industry in Canada will enjoy a continued growth in demand and will have to construct additional capacity to meet this demand.

The Canadian Pulp and Paper Association expects that pulp making capacity will increase by 2.8% per year through 1977 while total paper and board capacity will grow by about 3% per annum.<sup>7</sup> As long as the average growth in demand for products is greater than growth in capacity, it is expected that product prices will continue to rise or at least remain firm, making existing facilities increasingly more profitable. Several analysts have indicated that the availability of capital for expansion and for other purposes will be the primary limiting factor in the 1970's.<sup>8</sup>

Canadian analysts are generally optimistic about 1976 and 1977, but are more cautious about predictions beyond that.<sup>9</sup> Four analysts who were interviewed in January 1976 agreed that the industry would recover during 1976. However, the rate of recovery would depend on the recovery of the U.S. economy and the Canadian industry's ability to gain customers that were lost during the strike of 1975. For newsprint, "the decade of the seventies" promises the greatest tonnage growth of newsprint consumption (in the U.S.) in history.<sup>10</sup> Forecasts of U.S. newsprint consumption by 1980 vary from 11.2 million tons to 13.1 million tons.<sup>11</sup> The Food and Agricultural Organization of the United Nations also predicts that paper and paperboard products will enjoy a continued expansion in demand at least through 1979.<sup>12</sup>

Because such a large proportion of the newsprint and market pulp production is exported to the United States, the economic health of the Canadian pulp and paper industry hinges on the performance of the U.S. economy. At this writing, the U.S. and the Canadian economies are experiencing a slow but steady recovery through 1976 and 1977, and, if the various demand and capacity forecasts cited earlier are near the mark, a tight supply situation will appear again by 1979 with consequent high operating ratios and profits.



Pulp and paper specialists express some concern about the competitiveness of the eastern Canadian segment of the pulp and paper industry. The CPPA claims that Canadian producers are becoming high-cost, marginal suppliers.<sup>13</sup> Wage rates in Canadian mills are said to exceed those of their U.S. counterparts and many of the mills in Ontario and Quebec are old and less efficient than the new mills found in the southeastern United States. However, an extensive study of the taxes incident upon the pulp and paper industries of Sweden, Finland, the United States and Canada by Price-Waterhouse Limited, indicated that the tax burden incurred by the Canadian pulp and paper industry was not appreciably greater than tax burdens on the industries in the other countries studied.<sup>14</sup> In any event, these unfavourable conditions are tempered by the expected economic recovery.

## 2. Technology

Process improvements are generally a more economical and, in some cases, a more effective way of achieving pollution abatement than add-on treatment facilities. By-product recovery, process water recycling and less pollutive chemical pulping and bleaching processes all achieve pollution reductions as well as increased efficiency.

About 50% of the wood that is pulped by chemical means ends up in the waste water in the form of lignins, tannins, and other oxygen-depleting chemicals. Only a very small proportion of these materials are recovered and sold as useful products. Without large commitments to R and D and market development, it is unlikely that the recovery of lignins will significantly increase in the next ten years to the extent that waste water loadings will be affected.

The Federal Government is providing a grant to the Great Lakes Paper Company in Thunder Bay to install a new kraft pulping process conceived by Professor Rapson of the University of Toronto. This process includes complete recovery of the pulping chemicals, incineration of the organic residues (wood, sugars and alcohols, etc.) and is expected to reduce wastewater effluents to almost zero.<sup>15</sup>

Oxygen bleaching is an example of a new process which significantly reduces the waste water generated from pulp bleaching. This process is presently being installed at the Eddy Forest Products mill at Espanola. Thermo-mechanical refining is a pulping method which produces fibres that are longer and stronger than conventional groundwood pulp. Manufacturers in Europe make newsprint containing 100% TMR pulp. If TMR and other pulping processes (perhaps waste newsprint de-inking) could replace sulfite pulp in newsprint, a substantial amount of water pollution (i.e. the small sulfite mills) would be eliminated.

While many technical improvements and innovations have been made that reduce pollution as well as increase productivity, adoption of these improvements is a very slow process, particularly in the pulp and paper industry. For example, those responding to the Jegr and Thompson study felt that oxygen bleaching would not be adopted by most mills until well into the 1990's.<sup>16</sup> The adoption of new technology by this industry is slow because large amounts of increasingly scarce capital are generally required. Moreover, firms are generally reluctant to make investments unless the expected return is large enough to cover uncertainties and the risk associated with the process. Because firms get little or no financial return for pollution control expenditures, they would rather allocate their capital funds elsewhere, irrespective of the availability of capital and company profits. Nevertheless, technical changes which incorporate pollution abatement do take place in this industry. One of the best examples of this may be found at Great Lakes Paper in Thunder Bay. This company, which is the recipient of a substantial Federal grant, is the first to install the Rapson "effluent free" Process for kraft pulping.

D. THE IMPACT OF POLLUTION ABATEMENT COSTS

Articles which presage economic disaster and mass unemployment as a result of meeting the objectives of the United States Federal Water Pollution Control Act have become common place in the literature.\*<sup>17</sup> No such dire predictions have been published

\* The 1972 amendments to the U.S. Federal Water Pollution Control Act specify that, by 1983, all polluters must use the "best available technology" to clean up their effluents, and that by 1985 polluters will be forbidden to put any pollutants at all into U.S. waterways.

about the consequences of meeting pollution abatement requirements in Ontario, primarily because the environmental objectives set for Ontario mills are not as specific or uncompromising as those of the U.S. Federal Government.

Governments are justifiably concerned about the short-run adjustment costs of pollution abatement, particularly in terms of employment in communities which are entirely dependent on pulp and paper mills. It is, however, the contention of the authors that the employment losses due to achieving the water pollution abatement objectives prescribed for pulp and paper mills by the Ministry of the Environment will be exceedingly few if, indeed, there are any at all. Moreover, the costs to be incurred by the polluting mills will be well within their long-run financial capabilities. The evidence which will be presented in support of these contentions is not conclusive, but it weighs heavily against the conjectures that are offered in support of opposing views.

Prior to examining this evidence, it will be useful to look at the magnitude of the expenditures which the pulp and paper industry is already committing to pollution abatement. The Canadian Pulp and Paper Association reported that pulp and paper mills in Ontario spent \$8,051,900 in 1973 and \$10,889,700 in 1974, on water pollution abatement.<sup>18</sup> These totals amount to \$1.65 and \$2.22 per ton of total pulp and paper production respectively. According to Ministry of Environment officials, these figures tend to be

overstated since some of the expenditures are intended primarily for process improvement rather than pollution abatement. Perhaps a more precise estimate is provided from the Ontario Ministry of the Environment approvals files. Seven permits to construct waste water treatment facilities in 1974 by the Ministry of the Environment cost about \$6 million. These data are summarized in Table III-4.

Pollution abatement is not likely to generate severe adjustment costs because firms can avail themselves of tax concessions that reduce the impact of abatement costs on their profits. As explained in Chapter VI of Alternative Policies, the tax system actually shifts about 50% of the financial burden to the Provincial and Federal Governments. Of the estimated \$6 million spent on waste water treatment works by the industry in 1974, the profits of the involved companies were actually reduced by \$3.0 million, while Governments contributed \$3.0 million in terms of foregone tax revenue. A procedure for evaluating the costs and the effluent reductions of alternative pollution abatement technologies was developed and applied to two mills in Chapter VI of Alternative Policies.<sup>\*</sup> The effects which different tax concessions have on the costs of pollution control have also been calculated. This analysis indicated that the Eddy Forest Products mill at Espanola could conceivably achieve Ministry effluent objectives at no net cost to the mill by adopting the oxygen bleaching process in

\* This procedure is described and executed in Appendix G of Alternative Policies. A computer program has since been developed which will accomplish this analysis.

TABLE III-4

CAPITAL EXPENDITURES FOR WATER POLLUTION ABATEMENT  
BY THE PULP AND PAPER INDUSTRY IN ONTARIO

(000's of Dollars)

Year	CPPA Annual Survey of Capital Expenditures	Capital Expenditures for Industrial Waste Water Treatment Works for which Certificates of Approval were issued		
	<u>Total</u>	<u>\$/Ton Output</u>	<u>Pulp and Paper</u>	<u>Total for all Industries</u>
1971	20,592	6.02	6,519	42,904
1972	15,237	3.17	13,372	32,824
1973	8,052	1.65	5,323	52,558
1974	10,890	2.22	5,952	22,552

SOURCE: Frost, M. J., Report on Effluent Conditions of the Pulp and Paper Mills in Ontario-Annual, (Montreal: CPPA).

Industrial Approvals Branch, Ontario Ministry of the Environment.

addition to other treatment facilities. The Abitibi mill at Iroquois Falls (a sodium-based sulphite pulp and newsprint mill) could achieve Ministry objectives at an annual cost of \$640,000 over twenty-five years.<sup>19</sup> This amounts to about \$1.86 per ton of output per year. Based on estimated profit levels of \$20 per ton of output for sodium-base sulphite mills during 1971 and substantially higher profit margins in subsequent years, there is no reason to expect that this mill would have to close if it were to incur pollution control expenditures.

The total costs of meeting the Ministry's effluent objectives were estimated in 1971 to amount to \$118,000,000 in market prices.<sup>20</sup> Construction costs have soared since then so that the current estimate stands at about \$230,000,000. These costs would be incurred over a 10-year period. The combined contribution of the Provincial and Federal Governments in terms of tax revenue foregone, is approximately 50%. Therefore, the cost to the entire industry of the Ministry's current program would be in the neighbourhood of \$115,000,000 over 10 years. By contrast, the total capital expenditures undertaken by four Canadian paper companies during 1974 alone amounted to \$174,500,000.\*

\* The four companies included:

<u>Company</u>	<u>Capital Expenditures for 1974</u>
Abitibi	28,600,000
Domtar	72,400,000
Reed (Dryden)	23,500,000
Great Lakes	50,000,000
	<u>174,500,000</u>

Source: Annual Reports of the respective companies.

In comparison, the Federal Government has estimated that it will cost the pulp and paper industry an additional \$141,000,000 (in 1974 dollars) to achieve compliance with Federal SS and BOD<sub>5</sub> effluent Regulations under The Fisheries Act.<sup>21</sup> Again, this would result in a reduction in profits to companies of about \$70,000,000 and tax revenues foregone amounting to \$70,000,000. These costs would have to be incurred over a number of years as well.

Muller constructed a econometric model of the Canadian pulp and paper industry in such a way that the impact of changes in capital and operating costs could be tested directly.<sup>22</sup> A policy of mandatory secondary treatment of chemical pulp wastes and primary treatment of mechanical wastes and air pollution control was tested with this model. The model was run using different assumptions about company responses and about concomitant actions in the U.S. In no case did the short-run loss in employment exceed 3/4 of one percent of the industry's labour force, or about 600 jobs for all of Canada.<sup>23</sup> It follows from these findings, that the provision of adjustment assistance to those who do lose their jobs specifically as a result of pollution abatement would certainly be feasible and should not be expensive relative to the total capital investment involved in pollution control. Industry output was also predicted to drop by an almost insignificant 1.7%.<sup>24</sup>



Aird utilized an input-output (I/O) model to estimate the employment effects of compliance with Federal pollution control regulations.<sup>25</sup> This investigation indicated that there would be a net increase in employment within Canada as a result of the purchase and installation of pollution abatement equipment by pulp and paper mills. This would be due to the fact that, in comparison with production equipment, pollution control equipment is more likely to be manufactured in Canada. In addition, it is possible that pollution abatement activities are more labour intensive than production.

Predicting that employment losses will be small to "negligible" gives little solace to the few who are actually laid off. While we expect no mills to close or be closed as a result of environmental policies, there is no reason why retraining and relocation programs could not explicitly complement pollution abatement efforts in order to assure workers that their interests are being considered. At the very least, those firms which claim that pollution abatement will result in job losses should be required to provide supporting documentation.

Most pulp and paper mills in Ontario can "afford" to control their pollution to a much greater extent than they are presently doing. Therefore, adequate economic incentives are needed which will make polluting more costly than abatement. At the same time, these incentives should induce mills to seriously look for more effective and economic methods of pollution control.

CHAPTER III - FOOTNOTES

- 1 Ontario, Province of, Report of the Timber Revenue Task Force to the Treasurer of Ontario and the Minister of Natural Resources, October 1975.
- 2 Flowers, J. F. and Robinson, F. C., Proposed Policy for Controlling the Size of Clearcuts in Northern Forest Regions of Ontario (Toronto: Ministry of Natural Resources, Division of Forests, June 1976).
- 3 Hart, Howard, "CPPA Annual Report - A Canadian Balance Sheet: '76 should be better than '75, Not Quite as Good as '74.", PAPER TRADE JOURNAL, March 1, 1976, page 38.
- 4 Weaver, Kent, "The Paper Makers are Growing Less and Enjoying It More", FORTUNE, June 1976, pages 156 to 167.
- 5 Trelfa, Richard T., "Financial Trends in the Paper Industry" TAPPI, April 1976, Vol. 59, No. 4, page 65.
- 6 Jegr, K. M. and Thompson, K. M., THE CANADIAN PULP AND PAPER INDUSTRY - Threats and Opportunities 1980-1990 (Pointe Claire, P.Q: Pulp and Paper Research Institute of Canada, June 1975.)
- 7 Canadian Pulp and Paper Association, Canadian Pulp and Paper Capacity 1974 - 1977, (Montreal: CPPA, October 1975), page 2.
- 8 Mastro, Robert J., "Papermakers face \$43 billion shortfall in Capital Needs", PAPER TRADE JOURNAL, February 1, 1976, pages 1, 20 and 21.
- 9 Michaels, Bill, "Industry recovery due this year; bear sees lingering illness", CANADIAN PULP AND PAPER INDUSTRY, January 1976, pages 35 to 37.
- 10 Udell, Jon G., Future Newsprint Demand 1970-1980 (New York: American Newspaper Publishers Association, January 1971), page 40.
- 11 Ibid, and "Trends", PAPER TRADE JOURNAL, Vol. 160, No. 4, February 5, 1976, page 3.

- 12 "FAO foresees world wide deficit", PULP AND PAPER, Vol. 50, No. 2, February 1976, page 15.
- 13 Howard Hart, op.cit. March 1, 1976, page 38 and 39.
- 14 Price Waterhouse & Co. and Price Waterhouse Associates Ltd. "Summary of A Study of Taxation Practices Related to the Pulp and Paper Industry", Interim Report, August 1973, page 10.
- 15 Stevens, Fred, "First Pollution - Free Bleached Kraft Mill Gets Green Light", PULP AND PAPER CANADA, October 1975, pages 27 - 28.
- 16 Jegr, K. M., and Thompson, K. M., op. cit., 1975, page 42.
- 17 "Economic Impact of FWPCA Water Effluent Standards and Goals", PAPER TRADE JOURNAL, April 1, 1974, page 38;  
"Environmental and Social Factors", TAPPI, Vol. 59, No. 4, April 1976, Page 68;  
"Job Cost of 1983 Water Goals", PULP AND PAPER, Vol. 50, No. 3, March 1976, page 27.
- 18 Frost, M. J., Report on Effluent Conditions of the Pulp and Paper Mills in Ontario, Resurvey for Year 1973, (Montreal: CPPA, July, 1974), page 10;  
Frost, M. J., Report on Effluent Conditions of the Pulp and Paper Mills in Ontario, Resurvey for Year 1974, (Montreal: CPPA, August, 1975), page 9.
- 19 Alternative Policies, page 357.
- 20 Ontario, Province of, Ministry of the Environment, "A Proposal to the Ontario Government - Financial Assistance to the Pulp and Paper Industry to Accelerate the Water and Air Pollution Abatement Programs", April, 1973 (ENV/PF/3).
- 21 Canada, Environmental Protection Service, Status Report on Abatement of Effluent from the Canadian Pulp and Paper Industry - 1974, Report EPS 3-WP-75-61, (Ottawa: Environment Canada, Water Pollution Control Directorate, December 1975, page 25.
- 22 Muller, R. A., "A Simulation of Adjustment to Pollution Control Costs in the Pulp and Paper Industry", unpublished PhD. thesis, University of Toronto, 1975.

- 23 Muller, R. A., "A Simulation of Adjustment to Pollution Control Costs in the Pulp and Paper Industry", working paper 75-05 (Hamilton: McMaster University, June 20, 1975), page 18.
- 24 Ibid, page 16.
- 25 Aird, Keith L., Benefits from Industrial Production of Water Pollution Abatement Equipment for the Pulp and Paper Industry, Information Report E-X-24, (Ottawa: Environment Canada, January 1975).

## CHAPTER IV

### AN EVALUATION OF POLLUTION CONTROL POLICIES

#### A INTRODUCTION

The policy options that were reviewed two years ago in Chapter VI of Alternative Policies are equally pertinent in 1976. This chapter will summarize these policies and the assessment of them that was made in 1974. The background discussion about policy principles will not be repeated here. Instead, a reasonably detailed, but nevertheless briefer, evaluation of five policy options will be presented. These options are:

1. Continue the present approach.
2. Increase prosecutions under the existing legislation.
3. Increase financial assistance to the industry.
4. Introduce a system of effluent charges.
5. Introduce a system of pollution control delay penalties.

For any of these policy options to be acceptable, there are several conditions which should be satisfied. To begin with, an acceptable policy should be capable of achieving the requisite improvements in environmental quality. These improvements should not impose an undue burden on the industry, Government, or surrounding communities. Parties affected by pollution and its control should be treated equitably and the policies should be administratively feasible.

It should be clear from these conditions that no single policy is likely to be capable of successfully coping with all the forms of pollution caused by existing and new mills. What is required is a balanced program of policies which provides adequate incentives to industry to control pollution without imposing inordinate economic and social burdens. For this reason, each of the individual policy options that are presented in this chapter as alternatives to the current approach should be regarded as an amendment to, rather than a replacement of the existing policy program.

B POLICY OPTION I - CONTINUATION OF THE PRESENT APPROACH

1. Effluent Objectives and Regulatory Instruments

Whereas for air emissions the Ministry of the Environment sets regulations, water quality 'objectives' are established by the Ministry for water effluents. The Ministry attempts to obtain compliance with these objectives by negotiating a pollution abatement program with each mill. Under the terms of a program, a mill agrees to install the required treatment and disposal facilities over a specified period. Such voluntary programs may receive a 'Program Approval' by the Ministry. With a Program Approval, the firm is shielded against prosecution for the duration of the program. Voluntary programs may be made legally binding or control

programs may be imposed on mills by a 'Control Order'. If the programs specified by a Control Order are not implemented, the mill is liable to prosecution and fines. If human health is endangered, the Ministry may issue a stop order and close the mill immediately.

The situation for the establishment of a new mill in Ontario is similar to that for existing mills except that the Ministry can exercise stronger and more immediate control over a mill which has yet to be built. Such a mill has to have pollution control equipment that meets the Ministry's requirements and must receive Ministry Certificates of Approval before construction is undertaken. In the event that a new mill is designated under The Environmental Assessment Act (1975), the environmental impact of the mill, broadly defined, will be reviewed publicly. Approval for the mill will be given only if the environmental assessment and the project receive Ministerial approval.

## 2. Financial Assistance Programs

Three forms of financial assistance which were intended to lighten the burden of abatement costs to companies and to avoid undue social and economic repercussions, have been components of the current policy. These are:

1. The Ontario Pollution Control Incentives Act - a refund of the Provincial retail sales tax on pollution control equipment. This Act was repealed on April 1, 1976.
2. Pollution Control Loans - a loan of up to \$250,000 from the Ontario Development Corporation to companies which are unable to finance the purchase of equipment from their own resources.
3. An accelerated capital cost allowance on pollution control for Federal and Provincial income tax assessment - equivalent to an interest free loan in that it allows eligible companies to postpone a portion of their tax payments. This provision applies to air and water pollution control equipment that is acquired before 1977.

To understand the extent of the financial assistance offered by the accelerated capital cost allowance, it is necessary to outline the broader corporate fiscal context and its effect on the costs of industrial pollution abatement.

Discussions of the costs of industrial pollution abatement seldom distinguish between the total costs involved and the share of those costs which is actually borne by companies that purchase pollution control plant and equipment. The difference between the total cost and the cost to the company is made up by Government in



the form of reduced tax revenues which result from any cost increases that companies incur. This comes about by the normal functioning of the tax system. For example, if a company spends \$1,000,000 on pollution control equipment, then its profits before tax fall by \$1,000,000. With a combined rate of Provincial and Federal corporate income tax of 46%, the company's tax payments decline by \$460,000. Consequently, the net cost to the company of the \$1,000,000 worth of pollution control equipment is only \$540,000, the remainder being accounted for by the reduced taxes paid to the two levels of Government. In addition to this, the Federal and the Provincial Governments offer specific tax concessions applicable to expenditures for pollution control and the Provincial Government provides loans at favourable terms to assist companies in financing pollution control.

(a) Accelerated Capital Cost Allowances for Pollution Control

The reduction in taxes referred to in the above example does not take place within one tax year. Under special provisions for pollution control plant and equipment, a capital cost allowance of up to 50% per year for two years is allowed, so that up to 50% of the reduction in taxes would be available in each year.

Before this tax concession for pollution control was introduced, most pollution control plant and equipment was subject to the 20% rate on a diminishing balance basis that applied to most

forms of manufacturing and processing equipment. In comparison with this, the accelerated capital cost allowance reduces a company's tax payments in the first two years, and increases them by an equal amount in the years that follow. This is equivalent to an interest free loan which can be invested by the company to produce profits.

In 1975, the accelerated capital cost allowance of up to 50% per year for two years was extended to all equipment used in manufacturing and processing and this has largely removed the preferential tax treatment accorded to expenditures on pollution control.

(b) Accelerated Capital Cost Allowances and  
Unprofitable Companies

It is important to note that an accelerated capital cost allowance is useful only for companies which make sufficient profits against which they can offset the capital cost allowed on the pollution control equipment. If a company makes little or no profits in that year, it will obtain no immediate benefit from an accelerated capital cost allowance. Companies are permitted to carry non-capital losses forward for up to 5 years so that a company which eventually earns a profit can benefit from an accelerated capital cost allowance on capital equipment acquired in unprofitable years. However, it remains true that accelerated capital cost allowances as a form of financial assistance, operate to the benefit of companies only when they are making profits.

### 3. The Present Approach Assessed

Continuation of the present policy has the advantage of being understood by Government and industry and it will avoid open conflicts between Ministry officials and industry representatives. However, it is essential to realize that, in the present economic and legal context, companies have a powerful financial incentive to continue polluting the air and water. Firms seek to minimize their costs whenever possible. Pulp and paper mills have traditionally been able to use the air, lakes and rivers to dispose of their wastes free of charge. Waste recovery, waste treatment and proper disposal techniques are generally very costly to companies even when half of the costs are borne by the Government through the tax system. Hence, it is in the companies' interests to resist incurring these costs even when this may lead to prosecution and fines. In fact, firms have found that non-compliance has not normally resulted in prosecutions or fines. Between 1968 and the present, only twelve convictions under The Ontario Water Resources Act and five convictions under The Environmental Protection Act have been obtained against pulp and paper companies. The fines for water pollution averaged \$812 per conviction: for air, \$1,400 per conviction. Fines of this magnitude provide the companies with virtually no economic incentive to incur the much greater costs for pollution control. This is especially the case in the pulp and paper industry since there have been no convictions for water pollution by these mills since 1971, and only two for air pollution, both in 1974.



There are, however, several reasons for thinking that increased prosecutions alone will not achieve the environmental objectives being sought by this Ministry. Litigation can involve extended delays during which mills may continue to pollute. Even when cases come to court, there is no guarantee that the Ministry will obtain a conviction, in which case the collection of evidence and the investigations must start all over again. In the event of a successful prosecution, it is still up to the judge to set the fines and there is no assurance that such fines will be large enough to provide an adequate incentive for pollution control. Aside from the fact that judges are often ill-equipped to evaluate the environmental effects of the pollution, the purpose of the fines is either punishment or compensation for measureable damages done to downstream uses, and not specifically to induce firms to install abatement equipment. The argument that companies will undertake pollution abatement in order to avoid having their public images tarnished by repeated appearances in court for the same offence, may well be valid. However, some firms are likely to be insensitive to public opinion and this insensitivity will probably vary directly with the costs of abatement.

These considerations suggest that an increase in prosecutions offers no guarantee that the pollution problems will be reduced. Nevertheless, in the absence of any really new policy initiative such as the introduction of an effluent charge, or a pollution control delay penalty, an increase in prosecutions is the



The Ontario Development Corporation already provides loans for pollution control with the projects subject to certification by the Ministry of the Environment. These loans are presently limited to \$250,000 per project and repayments are geared to the needs and the abilities of the recipients. Between 1966 and March 31, 1975, 36 loans were made to pulp and paper companies, totalling \$2.8 million, under the Pollution Control Loan Program. A loan program, administered through the ODC, could certainly be expanded.

The pulp and paper industry has consistently lobbied for greater financial assistance. Therefore, an expanded loan program or more tax concessions would doubtless be welcomed by the industry. However, more financial assistance is unlikely to induce additional pollution control for the following reasons. Firms endeavour to minimize their costs. If pollution abatement still costs the company money after the assistance is provided and the expenditure gives the firm no return, then the company still has an economic incentive to resist installing the pollution control equipment. If, on the other hand, a mill intended to put in the abatement equipment anyway, extra financial assistance would only be a windfall. Although there may be a very small number of mills for which increased financial assistance might make a critical difference, such a program would fail to improve the current policy where improvement is most needed; that is in the provision of a strengthened incentive to act.

Another disadvantage of the approach is that further assistance will increase the already large share of pollution abatement costs currently borne by the Government. Furthermore, such a policy could well be unpopular with the public. It would also be inequitable in that it favours those companies who have been the least co-operative in the past. This could have consequences for other Government policies if it came to be thought that non-compliance with Ministerial objectives would be met with increased financial assistance. At the very least, a policy of increased financial assistance would lead other industrial sectors to demand similar and equally expensive consideration.

E POLICY OPTION IV - INTRODUCE A SYSTEM OF EFFLUENT CHARGES

1. Description of Effluent Changes

The concept of an effluent charge has a well established place in the economic theory of pollution control. In its simplest form, companies would be liable for a payment to the Government according to the amount of effluent they discharge. In a more sophisticated version, this payment might also be dependent on the quality and composition of the effluent, the fluctuations in its flow, the time at which it is discharged, and the state of the receiving water and its alternative uses.



The basic principle for setting the effluent charge is that it should be directly related to the damage caused by the effluent. If the damage per unit of effluent can be measured in monetary terms then it is conceptually simple to set the appropriate charge. This charge will then act as an incentive for companies to reduce their effluent loading for which they are responsible. Providing it is cheaper for a mill to install pollution control equipment than to pay the effluent charge, and this depends on the size of the charge and the cost of pollution control, the firm will reduce its discharge of effluent rather than pay the charge. This does not mean, of course, that a mill will either curtail its pollution completely or pay the charge and continue to discharge as before. A company which seeks to incur the lowest costs possible for a given level of production will attempt to find a balance between pollution control and payment of the effluent charge.

This general description of an effluent charge should not obscure the fact that effluent charges can be designed in many different ways to serve a variety of purposes. Table IV-1 summarizes the principle purposes that can be served by different formulations of an effluent charge.

Effluent charges of various types are currently being used in several European countries and a number of jurisdictions in the United States are considering introducing effluent charge. The Canada Water Act makes provision for an effluent charge and a first

TABIE IV-1

VARIETIES OF EFFLUENT CHARGES AND THE PURPOSES THEY CAN SERVE

PURPOSE OF THE EFFLUENT CHARGE

Effluent Charge (\$1/Unit of Time) Based on:	To Raise Revenue	To Supplement Environmental Standards or Objectives	Primary Instrument for Pollution Control, Supplemented by Environmental Standards or Objectives	To Optimize the Use of a Water Basin
Quantity of Effluent Flow (gallons)	X	X		
Quantity & Composition of Effluent (Weighted sum of gallons and tons)	X	X		
Quantity & Composition of Effluent, Condition of Receiving Water (Weighted sum of gallons and tons)	X	X	X	
Damage caused by Effluent (\$)	X	X	X	X

KEY: X indicates that a particular formulation of an effluent charge can, in principle, achieve specified purposes.

cousin of the effluent charge, the sewer surcharge, is in widespread use in Canada and elsewhere.<sup>1</sup> It is interesting that sewer surcharges have provided a useful incentive for companies to reduce their effluent loadings even though this was not the principle reason for introducing the surcharge.

## 2. Effluent Charges Assessed

It was noted in Table IV-1 that there are several bases on which an effluent charge can be levied. If each of these bases is regarded as a characteristic or combination of characteristics of the effluent, then an effluent charge will tend to discourage the particular characteristics of the effluent which are penalized. Thus, if a charge is levied solely on the quantity of effluent, companies may be expected to reduce the quantity of effluent they discharge. At the same time, however, they may well be induced to increase the concentration of contaminants in their effluent flow. If this happens, then despite the decrease in the quantity of effluent discharged, the environmental effects of the more concentrated effluent may be more serious than the effects of the greater quantities of the more dilute effluent.

The issue that has to be addressed, therefore, is whether a particular formulation of an effluent charge is likely to induce changes in the quantity, quality and timing of the effluent flow that will reduce or increase the environmental effects of the

effluent. If the effluent charge is effectively related to damage caused, then the likely result of an effluent charge is to reduce the damage. In the event that no convenient, unambiguous measure of damage is available (e.g. a dollar measure), then an effluent charge based on the primary damage-causing characteristics of an effluent is the next most likely to induce a reduction in the environmental damage. As the basis of the effluent charge becomes less inclusive, then the danger increases that companies will respond by modifying their effluent in a way that is environmentally harmful.

In the case of pulp and paper mills, a convenient base for an effluent charge would be a weighted sum of biochemical oxygen demand and suspended solids. The size of the weights might also be based on the particular location of each mill so that the overall charge would relate the incentive to reduce discharges to the damage caused.

It is obvious that the higher the effluent charge, the greater would be the incentive for a company to reduce its effluent discharges. Providing the mills have enough technical options for controlling pollution, and Alternative Policies suggests that they do,<sup>2</sup> virtually any degree of pollution control can be induced by setting the effluent charge at the appropriate level. To ascertain what this level is, close attention would have to be paid to the cost and effectiveness of pollution control techniques.

One of the main advantages of an effluent charge is that even when a mill has reduced its discharges to a level which is considered acceptable, it has a continuing economic incentive to improve its performance, and thereby reduce its payment of the charge. This should encourage the search for and development of new pollution control techniques since companies will always want to find ways of reducing pollution to save money.

Another way of looking at this is that even when a company has taken measures to reduce its discharges to an acceptable level, it still has to pay for the discharges that remain in addition to the often substantial costs of pollution control. The combined cost of controlling pollution and paying the effluent charge on the uncontrolled discharges may, however, be unnecessarily onerous. Furthermore, effluent charges generate considerable revenue and interested parties will inevitably ask about the uses to which this revenue will be put by the Government. The money could be rerouted back to the industry to help defray the costs of pollution control, but this would be administratively cumbersome, and possibly could undermine the incentives of the scheme.

In an attempt to resolve these problems with an effluent charge, the Pollution Control Delay Penalty, was devised. Since the pollution control delay penalty confronts similar data problems to an effluent charge, and requires supplementation by a program of legal prosecutions, both of these aspects will be discussed in the following section.

F     POLICY OPTION V - INTRODUCE A SYSTEM OF POLLUTION CONTROL  
          DELAY PENALTIES

1.    Description of the Pollution Control Delay Penalty

A pollution control delay penalty is intended to offer much the same kind of economic incentive for pollution control, without the complications associated with the revenues generated by an effluent charge. This is achieved by establishing a program of effluent reduction, defined in terms of permitted discharges which diminish over time, and automatically penalizing companies which fail to remain on schedule. The size of the penalty would be directly related to the divergence in any year between the permitted discharge and the actual discharge.

The fundamental difference between this scheme and an effluent charge is that if companies reduce their effluent discharges at least as fast as the prescribed rate, then the only costs they incur are those for pollution control. Providing that the penalty rate is sufficiently high, the scheme will never generate revenue. Indeed, if it does, then this is a signal that the penalty rate should be increased.

As with an effluent charge, a pollution control delay penalty lends itself most readily to controlling discharges which are made on a regular basis and in measurable quantities. Other kinds of discharges are best dealt with by enforcement of the existing legislation.

In the case of pulp and paper mills, a pollution control delay penalty might be applied to delays in reducing discharges of biochemical oxygen demand and suspended solids. The scheme could be extended to other water and air contaminants if it should prove successful.

As with the existing policy, a pollution control delay penalty requires that discharge objectives be established for each mill. While setting these objectives has been the sole responsibility of the Ministry, it has been the practice to consult with the companies to determine what is technically and economically feasible at each mill. In recent years, the public have requested a greater role in matters relating to the environment and it is timely to consider ways of involving the public in setting discharge objectives, whether or not they be used as the basis for a pollution control delay penalty. This would complement the role of the Advisory Council on Occupational and Environmental Health, which already involves various non-Government interests in setting standards that relate directly to human health.

Since a pollution control delay penalty is a somewhat novel device, it is worth explaining in some detail how it might be incorporated within the Ministry's current broad policy program of pollution abatement. The program that is outlined below could be applied solely to the pulp and paper industry, or, what may be more acceptable, to all establishments which discharge quantities of

BOD<sub>5</sub> and suspended solids in excess of some specified minimum. As Alternative Policies shows, a scheme which applied to all establishments discharging more than 3,000 lbs/day of suspended solids or 10,000 lbs/day of BOD<sub>5</sub> would include 23 of the 30 pulp and paper mills and 14 establishments in other industries (1973 data).<sup>3</sup>

2. Components of a Pollution Control Program Incorporating  
a Pollution Control Delay Penalty

- (1) Establishment of effluent objectives or regulations based on ambient quality standards and competing uses of the environment. These would differ from mill to mill according to local conditions.
- (2) Use of control orders, stop orders, prosecutions and fines for regulating the discharge of all contaminants, other than BOD<sub>5</sub> and suspended solids. Eliminate program approvals as a regulatory instrument. The discharge of BOD<sub>5</sub> and suspended solids would also be subject to control orders, stop orders and prosecutions in the event of spills or other exceptional circumstances.
- (3) Subject to consultation with interested parties, mills would be required to reduce their BOD<sub>5</sub> and suspended solids discharges at a prescribed rate. Because of significant differences in the technological problems and



the environmental conditions from mill to mill, it would be necessary to give some mills more time to implement their programs than others. Hence, mills would be grouped into three categories: A, B and C. Mills in Group A would have to reduce their effluent discharges at the prescribed rate over 2-year intervals, in group B over 3-year intervals, in group C over 4-year intervals, until they reach their specified effluent objective.

- (4) Imposition of an automatic financial pollution control delay penalty on mills which fail to reduce their discharges of  $BOD_5$  and suspended solids at the prescribed rate. This penalty would be commensurate with the cost of pollution control, and would be related to the effluent objectives. The penalty rate would be identical for all mills.
- (5) Continuation of the current policy on tax concessions for pollution control.

A more precise statement of a pollution control delay penalty may be presented mathematically:\*

$$p_C^t = M_C \times \frac{O_C}{D_C^t} \times (D_C^t - B_C^O \times r^t)$$

\* Readers not interested in these technicalities may pass directly to page 73 without losing the thread of the argument.

$p_c^t$  = the pollution control delay penalty for  
contaminant  $c$ , in year  $t$ , for a specific mill

$M_c$  = the penalty rate for contaminant  $c$ , identical  
for all mills

$O_c$  = the effluent objective for contaminant  $c$ ,  
specific to each mill

$D_c^t$  = the discharge of contaminant  $c$  in each year  $t$ ,  
for a specific mill

$B_c^0$  = the discharge of contaminant  $c$  in the base year,  
for a specific mill

$r^t$  = the proportion by which the discharge must have been  
reduced by year  $t$  for a mill to avoid paying a delay  
penalty. This proportion depends on the category into  
which a mill is classified.

The equation states that the pollution control delay penalty for  
contaminant  $c$  in year  $t$  applied to a particular mill equals the  
difference between the actual discharge of contaminant  $c$  by the  
mill ( $D_c^t$ ) and the amount of discharge for which the mill would  
not be liable for a penalty ( $B_c^0 \times r^t$ ) multiplied by a composite  
factor of ( $M_c \times \frac{O_c}{D_c^t}$ ). This factor consists of the penalty rate

( $M_c$ ), which is the same for all mills, and the ratio of the mill's objective for contaminant  $c$  ( $O_c$ ) and the discharge by the mill in year  $t$  ( $D_c t$ ). The role of this ratio is to ensure that as the mill approaches its objective, the delay penalty increases in step with the increasing cost of additional pollution control.

In order for the formula to work efficiently, it will be necessary to constrain the value of  $\frac{O_c}{D_c t}$ . It must be less than 1.0 since no mill is liable for a penalty once its objective has been reached. It must also be equal to or greater than some specified value to prevent the penalty from becoming too small to induce the required pollution control.

In the example shown in Table IV-2, the values of  $\frac{O_c}{D_c t}$  and  $M_c$  are specified as:

$$0.2 \leq \frac{O_c}{D_c t} < 1$$

$$M_c = \$0.10$$

Furthermore, the two mills which are analyzed in the Table are required to reduce their annual discharges of  $BOD_5$ , measured as the average 30-day discharge, by 50% every two years until their objectives are reached. These objectives are 125 tons  $BOD_5$  for Mill No. 1 and 50 tons  $BOD_5$  for Mill No. 2. The pollution control delay penalty scheme is assumed to become operative in 1977 and the base year  $BOD_5$  discharges are 2,000 tons for Mill No. 1 and 400 tons for Mill No. 2.

TABLE IV-2

## AN EXAMPLE OF THE OPERATION OF A POLLUTION CONTROL DELAY PENALTY

M I L L #1				M I L L #2		
Year	BOD <sub>5</sub> Discharge Objectives (30-Day Avg. Tons) No Penalty if achieved.	Actual BOD <sub>5</sub> Discharge (30-Day Avg. Tons)	Annual Penalty* \$	BOD <sub>5</sub> Discharge Objectives (30-Day Avg. Tons) No Penalty if achieved.	Actual BOD <sub>5</sub> Discharge (30-Day Avg. Tons)	Annual Penalty* \$
1977	2,000	2,000	0	400	400	0
1978	2,000	2,000	0	400	400	0
1979	1,000	1,300	144,000	200	400	96,000
1980	1,000	1,200	96,000	200	350	72,000
1981	500	750	120,000	100	200	60,000
1982	500	600	50,000	100	220	65,000
1983	250	500	150,000	50	80	45,000
1984	250	300	50,000	50	50	0
1985	125	200	113,000	50	50	0
1986	125	150	50,000	50	50	0
1987	125	125	0	50	50	0

\* Based on 12 thirty-day periods and rounded to the nearest \$1,000

Table IV-2 shows for each of 10 years following 1977:

- 1) The level of discharge from each mill for which there would be no penalty,

$$B_C^O \times r^t \text{ (columns 2 and 5).}$$

- 2) The actual  $BOD_5$  discharge for both mills  $D_C^t$  (column 3 and 6) and the annual penalty for both mills,  $p_C^t$  (columns 4 and 7)

These discharges and penalties are hypothetical although the base year discharges are representative of the amounts of pollutants from large and small mills in Ontario. Moreover, it is most unlikely that mills would delay the reduction of their  $BOD_5$  discharges if they were subject to the penalties shown in Table IV-2. The purpose of the table is to illustrate the magnitude of the penalties for delaying pollution control which are implied by a penalty rate of \$0.10/lb  $BOD_5$ .

### 3. Assessment of the Pollution Control Delay Penalty Program

It is important to stress that the pollution control delay penalty is not intended to raise revenue. Providing the penalty rate is properly set so as to exceed the costs of pollution control, companies would find it cheaper to control pollution than to pay the penalty. Consequently, the only costs the companies would

incur are the costs of controlling pollution to meet the effluent objectives. In the event that some companies decide to pay the penalty rather than install adequate pollution control, the penalty rates should be raised or the effluent objectives should be reviewed, and provisions should be made for this possibility.

Proper administration of the penalty system would require that uniform procedures be adopted for measuring the loadings of BOD<sub>5</sub> and suspended solids. Responsibility for measuring the effluents would fall on the mills although the effluents would also be monitored by the Ministry of the Environment. This requirement does not present an obstacle to the delay penalty scheme since many mills already measure their effluents in ways that would be acceptable. Furthermore, the Federal Government, after consultation with the pulp and paper industry and Provincial representatives, has established procedures for measuring various contaminants including BOD<sub>5</sub> and suspended solids. A similar declaration of acceptable measurement procedures should be made by Ontario for the purpose of administering the pollution control delay penalty.

The possibility of extended litigation once the delay penalty scheme is introduced seems to be considerably less than for the other policies. In the event of a dispute between a company and the Ministry of the Environment over the payment of the penalty, a court would have to decide two issues:

- (i) Whether the effluents had been measured by the appropriate procedures;
- (ii) Whether the company's or the Ministry's measurements should be used for calculating the penalty if these measurements differ.

Unlike the other policy alternatives, the court would not have to determine the extent of damage, if any, caused by the discharge of effluents into the waters of Ontario.

Despite the basic simplicity of the pollution control delay penalty, it may be resisted because it is misunderstood. Some may say that it is a license to pollute because it does not require zero pollution. In fact, the pollution control delay penalty is consistent with any effluent objective, however stringent. The penalty scheme is a means to induce mills to reduce their effluent discharges at a prescribed rate to the specified effluent objective. Providing the penalty for delaying pollution control exceeds the cost to companies of controlling pollution, it may be confidently asserted that the mills would meet the effluent objectives.

Misunderstanding may also arise over the revenues that the scheme may generate. However, as already noted, the generation of revenue is a sign that the penalty rate is too low or the effluent

objectives are too strict. The penalty rate and/or the effluent objectives should be adjusted accordingly. Once this has been done, there would be no more revenue from the scheme. In the interim, the revenues would go to the Provincial Treasury and could be earmarked for environmental projects.

The costs of administering the delay penalty are not expected to be very different from the costs of administering the Ministry's current policy. As it is envisaged, the delay penalty would apply to approximately 30 mills in Ontario (or to some 44 establishments if imposed on a discharge basis rather than to the pulp and paper industry alone. See page 70). Monitoring of these mills' effluents by the Ministry may require an increase in complement at the level of field operations, but this could be minimized by putting into operation the computerized data system that has already been developed by the Ministry of the Environment.

In summary, this program represents an evolutionary change in policy in that the pollution control delay penalty is the only novel instrument to be introduced. The purpose of the pollution control delay penalty is to provide mills with an economic incentive to reduce their  $BOD_5$  and suspended solid discharges at a steady rate until the effluent objectives are achieved.



In comparison with the current policy, it would provide companies with a more effective economic incentive for achieving the Ministry's effluent discharge objectives. These objectives could continue to reflect the broad range of regional, environmental, social and economic conditions found throughout the Province. However, the emphasis of the Ministry's work would shift somewhat from its concern with technical aspects of pollution control to the discharge of contaminants and their environmental effects. Responsibility for finding the means to control industrial effluent discharges would then fall squarely on the shoulders of the companies responsible.

CHAPTER IV - FOOTNOTES

- 1 Alternative Policies, Appendix B.
- 2 Alternative Policies, Appendix G.
- 3 Alternative Policies, page 408.

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